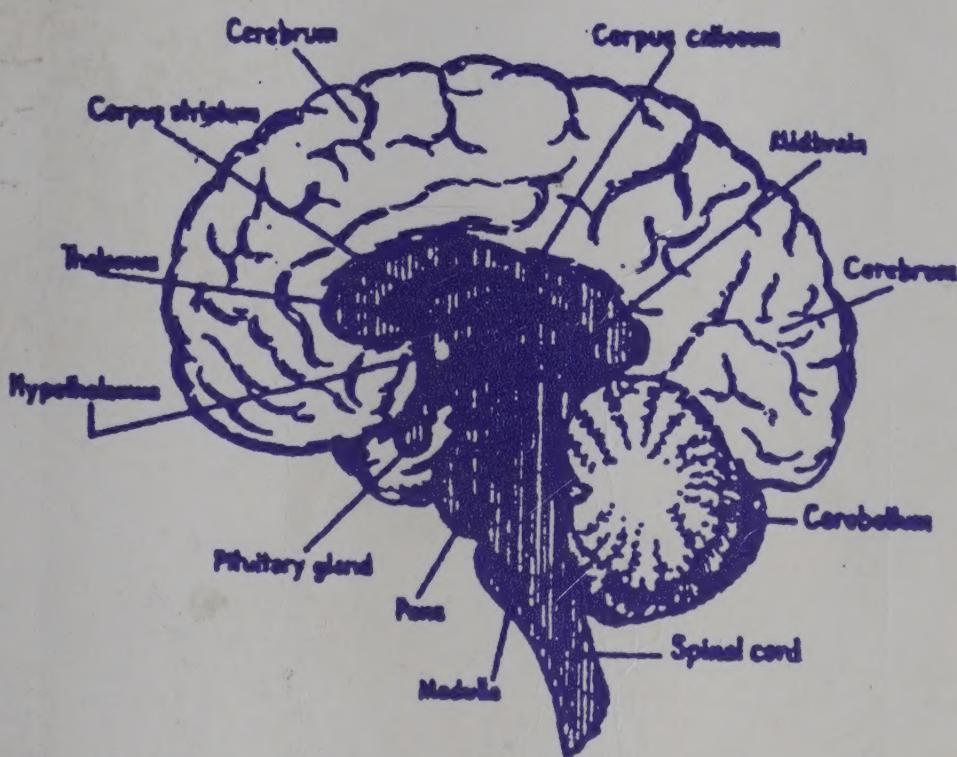


# Psychology

I PUC

(Revised Syllabus of 2007)

Prof. P. Nataraj



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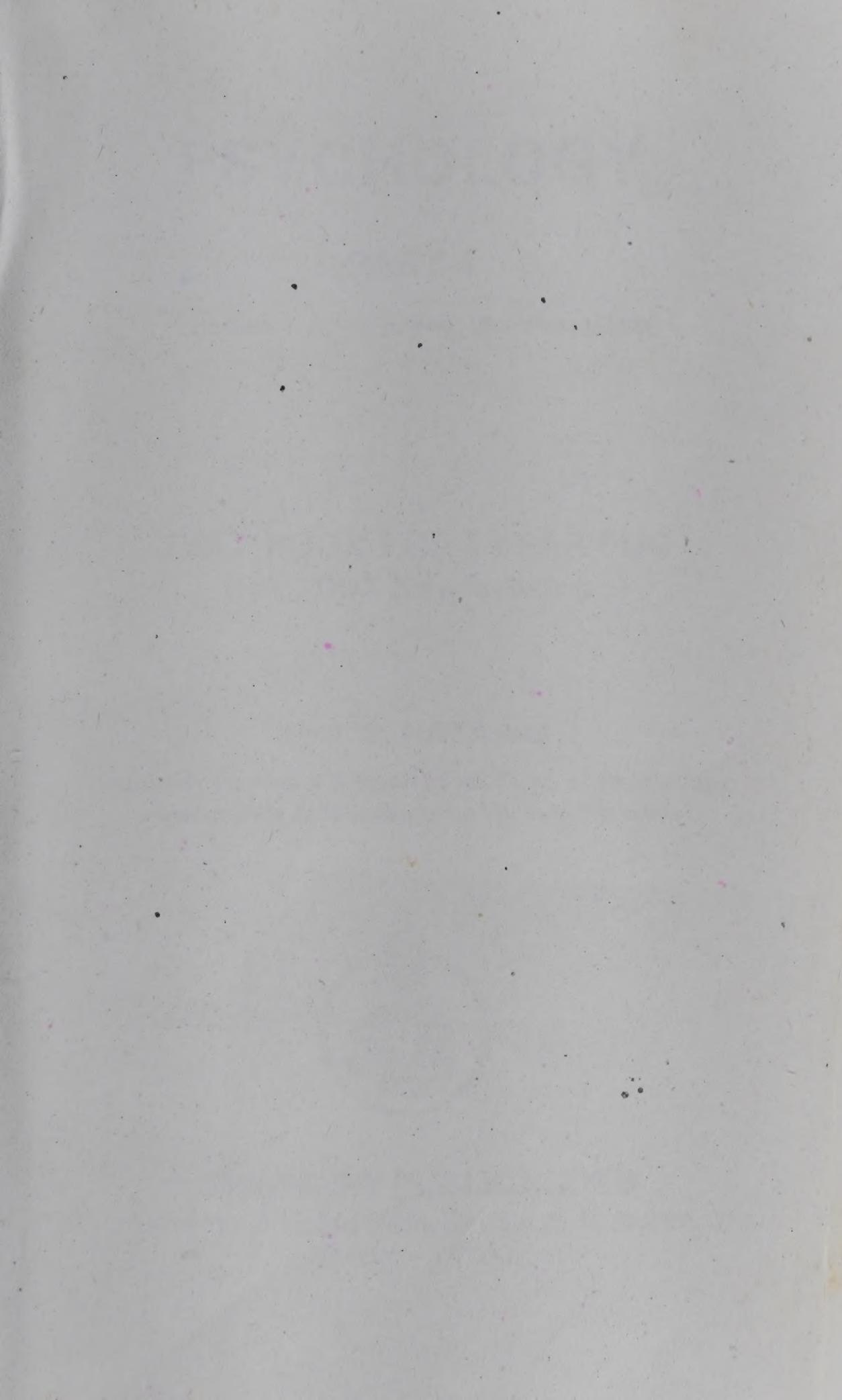
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# **PSYCHOLOGY**

## **PART-1**

**(Section : A - Theory, B - Practicals)**

**TEXT BOOK FOR 1 YEAR PUC**  
**(For 2004 New syllabus)**

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**Formerly Professor & Head of the Dept. of Psychology**  
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**SRINIVASA PUBLICATIONS**  
**Door No. 580, 3rd Main, 3rd Stage, Gokulam,**  
**Mysore - 570 002**

PSYCHOLOGY Part - I, - by P. Nataraj, Published by Smt. Meenakshi Nataraj,  
Srinivasa Publications, Door No. 580, 3rd Main, 3rd Stage, Gokulam,  
Mysore - 570 002.

Ph.: 2511388

Revised Fifth Edition, Reprint - 2009

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With the Author  
Price :  
Ordinary : **Rs. 140/-**

(For copies contact publisher)

Printed at :  
**RAJALAKSHMI PRINTERS**  
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To  
My Grandson



Sai SriCharan

## WHY I WROTE THIS BOOK

Indeed it is not small a delight for me to recall the help and encouragement I received from my esteemed colleagues and dear students of psychology throughout Karnataka, to my book "Psychology for beginners" Part I & II, which found several editions (8 Edns.). This is one of the reasons, which led me to venture this Revised Edition of PSYCHOLOGY - Part 1 for PUC students of Karnataka. Another reason is that the books prescribed by PU board are all authored by foreign psychologists, which are not only difficult for our students to understand but also very expensive to buy. The third reason is that the copies of the books prescribed are not available as I experienced. So to meet the urgent need of our students and teachers, this new Revised Edition is brought out. II PUC book will be ready by next year.

This new book covers the entire new syllabus of 2004, I year PUC. Section- "A" covers theory and section "B" covers practicals. I am sure this new book meets both the demands. The presentation of the material and illustrations at appropriate place are absolutely simple and easy to understand and to remember. Infact, to the best of my ability, I have endeavoured to make it truly and fully useful to students and teachers.

I gratefully acknowledge the help of my wife and my daughter Miss Namratha Nataraj and Prof. Mrs. M.G. Radhamani in preparing the script and reading the proof of this book. The General Manager of MMC Bank of Mysore for financial assistance for Publication. Sree Rajalakshmi Printing Press for printing the book, and finally students and teachers who are the constant source of encouragement to me.

### REGRETS :

Both the author and publisher regrets for:

1. Not supplying the book earlier than this, because the new syllabus copy of 2004, was available to the author very late.
2. 6 Pages from 87 are given numbers, 87a, 87b, 87c, 87d, 87e and 87f are inserted.

Author and Publisher

Prof. P. Nataraj

Mysore

June - 2004

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# PSYCHOLOGY

## CHAPTER I

### WHAT IS PSYCHOLOGY ?

#### Introduction :

1. On Friday the 30th January 1948 at 5.0 p.m., when *Gandhiji* was going to Birlamandir for prayer, an young man—Nathuram Godse, approached *Gandhiji*, touched his feet and shot at his chest thrice with his revolver and killed *Gandhiji* instanteneously. This great soul, was not only a Champion of Indian freedom struggle, but also, like Buddha, Mahaveera and Jesus Christ, preached and practiced truth, honesty, non-voilence, peace and love. Like Sri Ramakrishna Parama Hamsa, he had respect and tolerance for all religious groups and thus he became a martyr. People all over India, and abroad were shocked and wept at his death. Indeed the whole country was drowned in sorrow for days and months. He is dead but living in the hearts of billions, all over the world.

As a boy *Gandhiji* was very much afraid of darkness and devils. At school he was an ordinary student. Like other boys he smoke cigarettes, tasted non-vegetarian food, and even told lies, but later confessed his mistakes and took an oath tha he would never do it again. He kept up his oath till he breathed his last.

Before he went to South Africa he was an ordinary person and just a barister. He was so shy and timid that he did not play cricket only to avoid participation in a team. He had such a terrible stage fright, that he could not read his thanks giving letter before his friends and associates". Such a shy, timid and weakling person, suddenly held on to a great purpose of liberating our motherland from Britishers, and fought against the whites who were oppressing the blacks in South

Africa. How these lofty ideals, and noble goals have thoroughly changed his "Style of Life".? In contrast to his previous behaviour, he became strong, bold and courageous beyond measure. With his frail body he was walking miles together and fasting days together to achieve his cherished goals. Forgetting his shyness and timidity met many ministers, Viceroys and other great leaders of the world. Forgetting his stage fright and having firm convictions, and unshakable confidence stood before millions of our countrymen to pour out the message of his heart. He was very hard in his decision, firm in his conviction and determined in his effort. He was a true hindu at his heart, but secular in his attitude and behaviour. Preached and practiced truth, honesty, non-violence, secularism, and universal brotherhood. He remained great, died great, and became a martyr. How these metamorphic changes took place in him ?What has brought about these changes ? and how he became a great leader with no match in the contemporary world ?

2. *Dr. H. R. Sudarshan*", was born in a humble family, residing in Yamandur (Bangalore District). Graduated from Bangalore Medical College in 1977 and soon after graduation in his quest for spiritualism and social work, ventured to Mayavathi in Himalayas, and then he went to Ramakrishna mission at Belur (Calcutta). Got self-direction and conceived "The Mission of his Life", to become a dedicated social worker. With this mission in life, went to Biligiri Rangana Hills (B. R. Hills), to serve the cause of "Soligas" who are untouched by modern civilization. Started "Vivekananda Kalyana Kendra" to provide education, Vocational training, and medical services to those unfortunate Soligas. This shy young man sacrificed all his comforts and pleasures of life for self-actualization. This self-actualization not only got him a great satisfaction but also many state awards and a highly prestigious, "Right Livelihood award" of Sweden which is parallel to "Noble Prize". Indeed it is a matter of great pride to the people of Karnataka in particular and India at large. What prompted this young medical graduate to sacrifice everything and to dedicate his whole life for the upliftment of those

unfortunates and how he had self-actualization ?

3. One day an young lady—wife of a police officer attempted to kill her own twin daughters, whom she loved very much. One of them succumbed to stabbing and the other, sustained the injury, but survived with proper and immediate medical aid. The same mother after two years was acquitted on the ground she is mentally ill. Why she attempted to kill her own daughters, whom she loved very much ?

4. A great English novelist *William Somerset Maugham* (1874–1965) was suffering from severe pseudoneurotic stuttering from his early childhood. He was finding it very difficult to communicate with people easily. Inspite of this, he entered medical college and graduated successfully, but could not practice as a doctor due to severe stuttering. One day when he was very much worried, and depressed, he wrote his feelings, which gave him a lot of relief. He became a great writer. How this severe stutterer and medical man then became a great novelist ?

5. Sigmund Freud was a brilliant young doctor in vienna. After specializing in neurology, joined as a lecturer in neurology at vienna university. One day a patient with chronic headache" was referred to him for diagnosis. He wrongly diagnosed it as "Chronic localised Meningitis". For this wrong diagnosis he was terminated from services. This punishment turned out to be a blessing to him. He became a great exponent of psychoanalysis. He is the first person to trace the existence of unconscious and its importance in determining conscious as well as unconscious behaviour, nevertheless normal as well as abnormal behaviours. Thus his contribution is a milestone in the development of psychology. What prompted this neurologist to become an exponent of psychoanalysis ?

6. Notorious ~~elephant~~ poucher, smuggler and dreaded *veerappan* has taken many lives of elephants and men, including police officers for his personal gain. He became a big headache to both the government of Karnataka and Tamil nadu. Even the BSF and STF are not able to trap him inspite of their effort for months and years.

Apart from these great men who have sacrificed their lives to liberate their nations from foreign rule, and others who rose to great heights of achievements. We come across spouses who loved and married to find heaven on earth, start fighting like cats and dogs after marriage. Some with all the wealth and facilities at their command suffer from either psychoses, neuroses or psychosomatic disorders. Some students with hard work and studious habits, either fail or get poor grades or marks in their examinations. Some employees inspite of getting good salary, and other facilities are not happy with their jobs. Thus we come across various kinds of people, with varied attitudes, behaviour, values, and goals in life.

Now the question is, what inspires or motivates a person to noble acts of humanity, and impells another to brutal acts of violence, and some others to strive for self-actualization ? what prompted Gandhiji and Dr. Sudarshan to commit themselves to noble acts ? what prompted the police officer's wife and Veerappan to commit heinous crimes? and what prompted Somerset Maugham and Sigmund Freud to desert their field of specialization and one to become a great novelist and another to be the founder of psycho-analysis ? why some people with love marriage are not happy? rather fight with each other like cats and dogs? Why some others with lots of wealth and other facilities at their command have become either psychotics or neurotics ? Why some students inspite of their hard effort do not have good academic record ? Why some brilliant students do not make head way professionally ? Why some people are overwhelmed by problems of life, while others possess the secret of contentment and sound mental health. What makes some people to play their roles in their life's drama successfully and others fail miserably ? To find satisfactory answers for all these questions, you have to land into the realm of psychology.

#### *Definitions :*

The word *Psychology* was derived from two greek words- *psyche* and *logos*. *Psyche* means *soul* and *logos* means *discourse or science*. So literal meaning of the term psychology is

*the study of soul.* As psychology was purely speculative at the beginning it was known as armchair psychology. Hence it was defined as the *science of soul or the study of soul.* This definition was in vogue for many centuries. As the concept of soul was purely abstract and metaphysical in nature, this definition was discarded on the ground that it would come in the way of the progress of *psychology.* Later it was defined as *the study of mind or the science of mind.* This definition continued till the end of the last century and was then discarded on the ground that the concept of mind was equally vague and metaphysical in nature. Unless we know definitely what the mind means and what are its frontiers, we are not justified in using this concept in the field of science.

After discarding the above definition Wilhelm Wundt, the founder of psychology Laboratory in 1879, has defined psychology as *the science of study of conscious experience.* No doubt this definition is less vague and more tangible than the previous definitions, but it does not fully express all that is implied in the term psychology. Psychology does not confine its study to only conscious mental processes but it also studies unconscious processes such as dreams, hallucinations, delusions, phobias, and other mental aberrations.

A prominent psychologist tracing the evolution of definitions of Psychology has expressed in a funny way that psychology first lost its soul, then its mind, later its consciousness and now has a behaviour of some sort. In the beginning of the present century, when psychologists were making strenuous efforts to establish this science in the modern sense, the leader of the psychologists defined psychology in the following way "*Psychology is what the psychologists are Interested in.*" (Woodworth & Marquis 1947).

Another psychologist who belongs to the school of introspectionism has defined psychology as *the study of objective behaviour by subjective experience.* According to this definition, the individual who is confronted with a particular situation will have the experience of it. With this experience he can understand and predict the experience of another person who is subjected to similar or the same situation. For e.g.

a person who experiences burning sensation by touching a live coal, understands and predicts the experience of another person who touches live coal. Though this definition appears to be reasonable, it is limited in its application because the experiences of different individuals who are exposed to the same situation will not be the same. In the sense it differs either in degree or in kind or in both and hence this definition is very much limited in its scope.

According to McDougall the founder of Hormic school *the aim of psychology is to render our knowledge of human nature more exact and systematic, in order that we may control ourselves more wisely and influence our fellowmen more effectively.* Even this definition has its own limitation as it refers to only the human beings and not to the animals. (McDougall), 1961).

Then another psychologist has defined psychology as *the science of human behaviour.* Though the term behaviour is used by layman in a somewhat narrower sense, in psychology it includes not only motor behaviour such as walking, running, eating, talking etc, but also it includes the cognitive activities like perceiving, remembering learning etc. In addition to these activities behaviour also includes motives which determine and direct our overt behaviour. In short, it covers our overt behaviour and inner experiences and more definitely psychological activities, such as thinking, reasoning etc. Though this definition is fairly acceptable, in reality it is not complete and definite, as it needs further clarification and explanation. Further this definition appears to be narrow in the sense it refers to human behaviour and not to animal behaviour. In reality psychology includes not only human behaviour but also animal behaviour.

After an exhaustive observation of the field of psychology Woodworth and Marquis have defined psychology as *the science of the activities of the individual.* Here the word activity is used in a very broad sense. It includes *motor activities* like walking and speaking. *cognitive activities* (knowledge getting) like perceiving, remembering and thinking and *emotional activities* like, laughing, crying, sadness, jealousy

etc. These latter activities may appear to be passive yet they are activities, for they depend upon the life of the organism. Though this definition seems to be more comprehensive it is narrow because it does not include the behaviour of animals.

Then Munn defined psychology as *the science of experience and behaviour*. Experience is internal and subjective and it can be understood only by the individual who lives through that, whereas behaviour is overt and objective, and hence it is observable and verifiable by others. Example :— when you touch a live coal you feel burnt. This experience is something peculiar to the individual which is purely internal but hand withdrawl, screaming, fanning etc., are the manifestations of the inner experiences caused by burning which can be observed.

Today most psychologists include both behaviour and mind in the formal definition of psychology. Accordingly they have defined psychology as the "Scientific study of behaviour and mental processes and they are affected by the organism's physical and mental states and external environment.

Clifford T. Morgan in his books quotes that "Psychology is the science of human and animal behaviour, and it includes the application of this science to human problems".

After discussing each definition cited above and noting down the limitations of each definition, psychology is defined by this author as *the science of studying the cognitive, conative and affective activities of man and animals which are conscious or unconscious*. This definition, in addition to being objective, is also more comprehensive.

**Main goals of psychology :** The Goals are straight forward. They are (1) to describe, (2) to understand, (3) to predict, (4) and to control or modify behaviour and mental processes. There is logical order to these goals —We must be able to describe behaviour or mental processes accurately before we can understand them, understand them before we can make predictions with confidence and make reliable predictions before we can attempt any changes.

## Scope of psychology

Just as every science, whether it is physical or biological or social has its own scope, psychology too has its own scope. Indeed the scope of psychology is as wide and varied as human activities are. Infact, the wide scope of psychology can be seen from the number of branches of psychology and the different walks of life in which psychological principles are applied for the benefit of man. Some of the important branches of psychology, are—General psychology, Social Psychology, Child psychology, Abnormal psychology, Physiological psychology, Animal psychology and Parapsychology.

In recent years the research findings of psychology are being used to improve the general efficiency of the individual in various walks of life. So, various branches of applied psychology are developing independently. Some of those applied branches are Clinical psychology, Industrial psychology, Educational psychology, psychology of Crime, Military psychology etc., Now let us have a brief account of each branch of psychology.

### A. Branches of Psychology

#### (1) General Psychology :

As the name itself indicates, it is concerned with the establishment of the basic principles of human behaviour. It studies the activities of man such as, attention, perception, drives and motives, emotions, intelligence, learning, memory, and tries to evolve certain fundamental principles underlying them. Thus this branch of psychology constitutes the basis for all other branches and application. Generally it studies the normal human adult, though of course reference is made to some of the other aspects also. But a detailed study of children and their developments, animals and their behaviour, the abnormal and his treatment etc., do not come within the scope of general psychology. The children, the animals the abnormal etc., are studied in detail in the respective branches of psychology. Yet general psychology enjoys the status of

being the basis for all other branches and applications.

## (2) Social Psychology :

Every individual is born into a society. Every society whether it is eastern or western has a culture, tradition and religion of its own. These will have their deep impression on the individual and determine his cognitive, conative and affective activities to a very great extent. He is not free from the influence of the society at any stage and in every walk of life. So social psychology studies the individual in the context of the society to which he belongs. It studies the way in which the individual becomes a member of and functions in a social group. The problems with which it is concerned are, socialization of the individual, inter group and intragroup relations, propaganda, public opinion, attitude, attitude change, prejudices, social motives, juvenile delinquency, social perception, social intelligence, etc. As man has become more and more interested in group understanding and living at the national and international levels, social psychology has gained great importance as an applied branch of psychology. Social psychology, in order to study its problems, adopts methods of observation, field investigation method, experimental method etc. The important social psychologists who have contributed much to this field are : Kimbal Young, Charles Bird, Britt, Bogardus, Murphy, Allport, Kuppuswamy etc.

## (3) Child Psychology :

Child psychology studies the individual from his birth upto puberty, i.e., upto 12th year. It studies the various developments and behaviour of childhood period. The wise statement viz. *Child is the father of man* indicates the child psychology. Childhood is very important because it is during this period the developmental processes are at work with great vigour. So whatever happens during this period will have lasting impression on the individual. The normal or abnormal behaviour of the individual at later periods depend upon the childhood experiences. The success or failure, and the adjustment or maladjustment of the individual depend upon

the childhood period. 'Child psychology studies various developmental activities like, sensory, motor, emotional, motivational, intellectual, social and personality developments. While studying these developments the interaction of heredity and environment are taken into account. Child psychology for its studies generally adopts biographical method, case history method, observation method, experimental method etc. Also uses various tests and instruments for collection and interpretation of the data. Further it follows either cross-sectional or longitudinal approach in its study of the developments. The best known centre for such a study is the institute of Arnold Gessell of Yale University. The important psychologists who have contributed much to this field are Brooks, Carmichael, Arnold Gessell, Havighurst, Thompson, Guttridge, Jersild, Bridges, Elizabeth B. Hurlock and so on.

#### (4) Abnormal psychology :

Abnormal psychology studies the abnormality of the individual. Abnormality is unusual, a typical or far away from the norm, or the standard. It is non-conformity to the cultural or social norms to which the individual belongs. Every individual has to behave in a way that is suited to his age and sex group to which he or she belongs. The abnormal person is not completely different from the normal. Both the normal and the abnormal have the same characters and behaviour, but they differ in degree and not in kind. Abnormal psychology is concerned with the theoretical aspects of abnormality and helps us to understand the nature of abnormal behaviour, and the importance of frustrations, conflicts and pressures in causing abnormality. Whereas clinical psychology provides methods of diagnosing and treating the patients. Abnormal psychology classifies the abnormal deviants into neurotics and psychotics depending upon the severity and the extent of disorientation in thought, speech and actions. Freud, Adler, Jung, Charcot, have contributed much to this branch of knowledge. The discovery of the concept of unconscious by Freud is the greatest contribution to abnormal psychology. Consequent to the dawn of this branch of knowledge : the torture the patients were

subjected to and the suffering they lived though are very much reduced. Thus abnormal psychology has contributed much to dispel the wrong notions people had about mental patients, and to alleviate the suffering of the patients,

#### (5) **Physiological Psychology :**

Physiological psychology is concerned with the physiological correlates of psychological functions. The physiological structures concerned with behaviour are nervous system, sense organs and glands. In addition to these, motor organs are also concerned with the behaviour of the organism. So to understand the behaviour we have to understand the structures and their relation to response mechanism. Of these different structures we are very much concerned with the nervous system and especially the central nervous system to understand the functions of the mind. However, the stimulus from the physical or social world around us stimulate the sense organs. The receptor organs there, receive the stimulus. This will be communicated in the form of neural impulses through the sensory nerves to the brain via the spinal cord. The appropriate centre in the brain after receiving the stimulus, directs (through motor nerves) either the glands or the muscles concerned to react in an appropriate way to the environment, thereby helps the organism to adjust to the environment. Scientists like Lashley, Sherrington and Morgan have contributed much to our understanding of human behaviour from the point of view of the physiological structure, particularly of the brain. Physiological psychology assumes an important place in the history of the development of psychology as a science. Experimental psychology began with the study of physiological process in the laboratory. In recent years physiological psychology is coming close to neurology and biochemistry. In course of time it is no wonder if neurology and biochemistry by their valuable contribution to our understanding of human mind and its working, are to replace psychology.

#### (6) **Animal Psychology**

Animal psychology studies the behaviour of animals. The

study of animal's behaviour is useful not only to understand the behaviour of animals but also to understand, to some extent the behaviour of man. The rationale behind the study of animals is that there is continuous life process. As there is similarity in structure, there is also similarity in functions or behaviour of man and animals. That is why man is called a rational animal. Modern studies on psychological problems have shown that there are many common areas between man's and animal's behaviour. In spite of the differences between man and animal the data collected on animal behaviour are found to be useful to understand human behaviour at its simplest levels. Studies on learning, emotions, drives and localization of cerebral functions are made on animals and the principles or theories arrived at, are applied to human beings. Infact the results obtained from animal studies are simple, direct, dependable and unaffected by cultural factors. Animal psychology has also contributed to the development of scientific laboratory experiments and techniques to study psychological problems. The important contributors to this branch of knowledge are Thorndike, Pavlov, Morgan, Kohler, Watson, Lashley, Skinner and so on.

### (7) Parapsychology

Parapsychology is developing to be an accepted branch of psychology. For a long time it was not given recognition because, it depended upon the anecdotal method for collection of data. It deals with problems like extra sensory perception telepathy, clairvoyance, etc. Telepathy is nothing but the action of one mind on the other at a distance through emotional influence without communication through sense. Clairvoyance is the faculty of seeing mentally what is happening or existing out of sight. It also deals with extracortical memory (memory of previous birth). J. B. Rhine is the founder of this branch of psychology. Following the work of Rhine in America and at the University of London, most of the problems of parapsychology are investigated under strict experimental conditions. However, many of the problems and explanations are still in the theoretical stage. This branch is

also known as *psychic research*. Professor Ramakrishna Rao and Professor L Narayana Rao Powar have done some work in this field.

## B. Application of Psychology

As said already the principles of psychology have been applied to various walks of life for the benefit of man. Some of the areas of application are :

### (1) Clinical Psychology :

Clinical psychology involves the application of the principles and theories of abnormal psychology in the diagnosis and treatment of emotional and behavioural problems such as, mental disorders, delinquency, mental retardation, alcoholism, drug addiction and so on.

If we trace the history of abnormality, we find that it was believed to be incurable and it was due to the curse of God and mischief of evil spirits. Hence the patients used to be treated very cruelly or they were untreated and made to suffer till their death. Thanks to the work of Charcot, Freud, Adler, Jung and others who made us to understand that mental disorders are not incurable rather they can be treated and cured by psychotherapy and other therapies. If the disorders are organic in nature they can be treated with the combination of medical therapy and psychotherapy and in some cases by psychosurgery. On the other hand, if the disorders are functional in nature, they can be treated by psychotherapies, such as Roger's client centred therapy, psychoanalytical therapies, etc. Thus the therapy depends upon the nature of mental disorder. The clinical psychologist in his work uses many psychological tests, interviews, and case histories to diagnose the disorder. Depending upon the disorder, he adopts the appropriate therapeutic technique to treat patients. Nowadays clinical Psychologists adopt holistic approach in the treatment of the patients because every disorder is a product of organic, psychological and sociocultural factors. The recent trend in therapy is to treat not only the patient but also his relatives and friends to make the therapy effective.

The principles of mental hygiene finds a place in the field of applied psychology.

## (2) Industrial Psychology

Industrial psychology is concerned with human aspect in Industry. The progress of any industry not only depends upon the machine and the raw materials but also upon the personnel who mans the machine. Every person cannot handle the machine. It is only the right man who can handle the machine efficiently. So industrial psychology is concerned with the selection of the right man to the right job and the right job to the right man. In other words, it is primarily concerned with vocational guidance and selection. Both selection and guidance are made on the basis of aptitude, interest, intelligence and the personality of the individual. For this purpose the industrial psychologist use required tests, questionnaires and conducts interviews.

Industrial psychology is also concerned with many industrial problems such as, accidents, absenteeism, industrial unrest, industrial morale, incentive system, training programmes, market or consumer research and human relations in industry.

Another specialized branch of industrial psychology is *human engineering*. The *human engineer or human factor scientist* works with industrial, electrical, and mechanical engineers in designing of new equipment and thereby to produce the maximum with minimum effort. This branch of psychology is developing faster than any other branch of psychology and will continue to expand greatly in future. As our Technology becomes more complex the need for designing new equipment with human operator in mind increases in importance. The equipment must be designed in such a way that the employee can function effectively as an operator. It is the job of the human engineer to fit man and machine together in such a way that both should function with maximum efficiency. The important industrial psychologists are Vitejs, Joseph Tiffin, Ernest J. McCormic, N.R.F. Blum, Maier, Smith and others.

### (3) Educational Psychology

Educational psychology as the name implies, involves the study of psychological problems related to education, measurement of achievement, improvement of teaching techniques, exceptional child, under achievers, student teacher relation and emotional, intellectual and adjustment problems of students. Its primary concern is educational guidance and selection.

Educational psychology makes use of the principles of learning, memory, thinking, attention, perception, motivation etc, for teaching and guidance.

Since educational psychology has developed particularly in the context of the school it is primarily interested in children from the level of nursery school. It helps to guide the mal-adjusted child and to develop normal personality by overcoming the problems. Educational psychology not only confines itself to the use the principles developed by general psychology but also develops special areas with regard to teaching of special skills like reading, spelling and arithmetic. The educational psychologist is generally employed by a college or university for teaching and research.

### (4) Psychology applied to crime

Criminal behaviour is antisocial conduct that violates the laws of the land and the society to which he belongs and entails some penalty. What constitutes a crime varies with time, place, culture, age and sex. For example, when there is prohibition, consumption of alcohol is a crime. In civilized society adultery and rape are crimes. But certain acts like treason, murder, incest and theft are crimes at all times and all places. There are some exceptions also. Crimes committed by children and adolescents under statutory age called *delinquencies* and some states call it *Juvenile delinquency* if it is committed by an individual below sixteen years of age.

It is found from studies that crime is not due to a single factor but to a number of factors such as heredity, physique, neuroendocrine factors, social disorganization, family disruption, economic factor and psychological factors like intelligence.

nce, neuroses, psychoses, psychopathic personality and so on. Thus a combination of many factors makes an individual to become criminal.

Infact, psychology as a revolt against the old method of treating the criminal with punishment, has suggested reformation and retraining of the criminal. The largest contribution that psychology has made is in changing the attitude of the society towards Juvenile delinquents. The introduction of juvenile courts, reception homes, guidance clinics, training schools are all due to the impact of psychology. Psychological study of juvenile delinquency has also helped social agencies to prevent crime to some extent. A juvenile delinquent and near delinquent if properly dealt with and rehabilitated, prevention of crime could be achieved to a large extent. The roles of social psychologist and the abnormal psychologist are very significant in preventing crimes.

#### (5) Psychology applied to military affairs .

The application of psychology to military affairs began with the introduction of psychological tests for classification of army personnel during the first world war in America. Since many soldiers were illiterates, the army psychologists, constructed non verbal intelligence tests for the purpose of assessment and classification. During the second world war the psychology unit has developed into a full fledged branch of the army. During war time, in order to maintain the civilian morale and to protect the children against psychological shock by air raid, the principles of social psychology are utilized. Further the military psychologists adopt many psychological measures to mobilize the entire strength of the country and to detect the weakness of the enemy. Psychological tests are used for selection and classification of recruits to various ranks and grades. Further psychological tests are used to spot out the problem cases which may prove to be a handicap and liability at the time of danger and tension. Infact, an efficient army cannot afford to have the emotionally unstable, immature, psychotic and perverted officer in its rank. Such a personnel must be weeded out.

In order to maintain the morale of one's own side or to break the morale of the opponents, the principles of psychology and particularly of suggestion are used freely. Infact, the so called cold war is nothing but a psychological warfare fought with the help of psychologists. The principles of psychology are utilized to treat the war neurotics and to rehabilitate the servicemen after war. Some of the special psychological problems of these service men after war are,-vocational readjustment, managing the feelings of hostility developed within one self, psychological disturbances caused by war, such as restlessness, disturbed sleep, hyper-emotionality, marital adjustment etc. Thus psychology is used to deal with many problems of military affairs.

#### (6) Mental Health

*"A sound mind, in a sound body, in a sound society"* is the goal of World Health Organisation. So much of importance is given to physical and mental health today than ever before, because man is subjected to a lot of stresses and strains today than ever before. That is way psychologists have rightly called that "*Twentieth Century is the age of anxiety*". The world is in the brink of neuclear war, and man is in the grip of cold war. This fear is disrupting personal, national and international life and thereby causing grief and social unrest. Economic inflation, rapid scientific and technological developments, are causing unemployment and poverty to billions of people all over the world and more so in India. Population explosion is of great concern to the world and India in particular. It is causing unsurmountable problems in social, political, economical, educational and health areas. Further racial, national, religious, language, caste, creed, and such other prejudices are causing social tension and unrest among people in the world, and it is more so in India. All these imbalances are causing insecurity, restlessness and anxiety among people all over the world. Unless some serious measures are taken by all the concerned to prevent minor or major maladjustments, to cure if they occur and to maintain mental health, the world is going to be a lunatic asylum in course of time.

No man is perfectly healthy either physically or mentally. Some are more healthy than others and some are unhealthy. A person is said to be mentally healthy when he can "attain and maintain satisfactory human relationship." Man as a member of one or the other society has to make adequate adjustment to his fellow beings and avoid undue conflicts, frustration, and pressure either from within or without or both. Nevertheless he has to adjust to his occupation and events which occur in and around him every day. The individual who adjusts himself to the world of people and events around him and finds satisfaction in life, will not only be healthy and happy but also offers greatest satisfaction to the society at large.

Mental health programmes of WHO has the following objectives :

1. Preventing minor as well as major maladjustments which make man not only unhappy but also less effective and efficient in all his dealings.
2. Diagnosing and curing maladjustment of any magnitude if it occurs.
3. Preserving mental health by providing a congenial atmosphere.

This will be done at three levels : Organic, psychological and socio-cultural levels. (1) At "*Organic level*"—(a) during prenatal period the pregnant lady must be provided nourishing food, protection against possible dangers and help smooth delivery for the birth of a healthy baby. Adopting measures to avoid the birth of mentally deficient baby ; (b) After birth baby must be provided nourishing food, medical facilities and care, so that the child brought up in this way can adjust efficiently to men and matters around him. (2) At "*psychological levels*" the individual must be made to develop a sound personality which can face failures, conflicts and anxiety, without being disturbed and adjusts to realise in a realistic way. (3) At "*socio-cultural levels*" the individual must be provided wholesome social contact and environment. He is to be guided to have marital and occupational adjustments. He is to be taught to live up to his age, and sex expectation of

his society. Further home, school and colleges must adopt mental health programmes, to achieve the objective of WHO.

### (7) Psychology in Law

Law is a formal rule or norm of behaviour approved by legislature at the state level or by Parliament at the level of the country, in the interest of safety and security of life and property of its people. People have to behave in accordance with the rules or norms of the state or the country to which they belong. Any violation of these norms is punishable under law. So law deals with regulation of human behaviour. Whereas psychology deals with "how" of human behaviour and it has much to do with law. For effective implementation of law and to deliver justice, we have to understand the behaviour of the judge, jury, lawyer, defendant or the criminal, witness and all the concerned. Psychology helps to understand how people, whatever be their duties and responsibilities, yield to suggestion and persuasion. How they yield to the pressure of the group and "conform" to it. How "influence" involves personal change of attitude or opinion. Both conformity and influence are important aspects of legal psychology.

There is a growing discontentment with absolute and pre-scientific concepts of human nature on which many laws and legal practices are based. Example : "Insanity" and 'criminal responsibility'; According to law the test of insanity is "the defendants' intellectual inability to differentiate between right and wrong". This concept is unrealistic and not based on psychological knowledge rather it reflects layman's misconception of the nature of insanity. Psychologically an insane person often knows that his act is wrong and [forbidden by law but still commits it as a result of irresistible inner urge or imbalance" [Mental disorder]. For example, Pyromania, Kleptomania, dyspsomania, paranoid, schizophrenia, paranoia, etc. This fact is to be borne in mind while declaring whether a person is insane or not and to have legal practice.

Psychologists have traced the characteristics of delinquents and criminals, in their effort to identify the cause of antisocial

behaviour. Though many factors lead to antisocial behaviour, studies have given importance to attitudinal, emotional and motivational factors stemming at least in part from early childhood experiences. In the treatment of delinquents and criminals the services of psychologist are necessary at every stage. The work of psychologists in court, clinics, prisons, training schools for juvenile delinquent and other peno-corrective institutions falls within the areas of clinical and counsellng psychology.

The earliest application of psychology to law was concerned with testimony and court room procedures. Further conditions affecting the accuracy of observation and report are investigated through "aussage tests" and other controlled procedures. "aussage" is a German term which means "testimony or report". Studies reveal that testimony or reports without errors are exceptions, and people "fill in" gaps of their observation or recall the scene with plausible details. Accuracy drops to a very low level when the questions asked under cross examination are hostile, confusing and double barrelled type. Observation made under intense emotional state tends to decrease the accuracy of report. Leading questions mislead the witness to accept something that is not observed. Data gathered suggests variability in the sentences passed by different judges for similar crimes. Though Judges' decision should be "impersonal", it is inevitable that the decisions reached are influenced by his personality, point of view and environmental background. In the same way, the jury's perception of the reported facts and their ultimate decision of the case may be influenced by his prejudices towards racial, national, religious, economic, occupational and other groups. Social stereotypes and snap judgements based on appearance, or mannerisms also affects the jury's evaluation of defendants, witness and other participants, in the trial. Psychology of law is concerned with accuracy of testimony, power of suggestion, conformity, influence, uses and abuses of lie detector and how juries can be swayed by suggestion. Major area of legal psychology is concerned with lie detection. The technique used for this purposes are : (1) free-association test. (2)

physiological indices of emotion, such as changes in respiration, blood pressure, and galvanic skin response (GSR). These indicators will be taken into account to identify the criminals.

Ausage tests are found to be highly useful in training law students who play various roles—witnesses, Judge, Jury, Prosecuting attorney, defense counsel, court reporter, etc.

Nowadays psychologists are called upon by the Courts to testify as expert witnesses. They have to testify the defendant's mental condition and its relation to the criminal act committed. Psychologists can also aid the development, revision, and interpretation of laws by submitting relevant research findings in court testimony. They can also serve as consultants to special legislative committees concerned with revision of law and collaborate for teaching and research in law colleges. The other areas of legal practice and formulation of laws, where psychological knowledge is essential are, insanity, drug addiction, alcoholism, sexual offenses, trial of juvenile delinquents and their reformation and rehabilitation, civil rights and liberties, inter and intra group relations etc. Thus psychology can contribute its mite to law.

### (8) Psychology in Administration

The term administration refers to management of public affairs or affairs of the government. It involves a social situation and human relation. The efficiency in management and consequent progress in the organisation, largely or solely depend on "good human relation" proper motivation, suitable incentives when required and proper management planning."

By "*management planning*", we mean, planning manpower, proper selection, training, placement, promotion, motivation etc. Planning has to take into consideration some significant events, and changes in the organisation over the next five to twenty years. It is necessary to take note of manpower needs at different times in future. Prediction of behaviour of the employees job training for the present and the future etc, come under management planning. (Gilbert and Helen Jessup pp. P19-123, 1975).

The success of any organisation and efficiency in performance largely depend upon "*good human relation*" in addition to proper selection, training etc. Good human relation is something more than winning friends and influencing people, "It is a means of getting people "to want" to work together, to get the common goal of the organisation", Good human relation helps, to maintain discipline, promotes communication, solves personal problems, stimulate interest in the job, fosters co-operation and induce workers to work willingly.

Successful administration needs the development of "*team spirit*" (Group morale). This helps to overcome, indifference, tiresomeness, and antagonism of employees towards management. Induce employees to identify with the organisation and the group, and to participate in the solution of problems of the organisation. It offers the employees the feeling of importance and satisfaction, helps to avoid hostility, suspicion and distress towards others, and at the same time promotes friendliness.

In order to get team work done, the officer has to "acquaint with each employee" with all interest in them. He has to "set targets", offer "direction" and "make them understand" what they have to do, has to enforce "rules, maintain discipline, must be "fair but firm". He has to foster "co-operative spirit" and seek the help" of the employees to solve the organisational problems. Must have "respect for the opinion of colleagues" and to "avoid conflict" and "excessive supervision" "Greet every official warmly" offer "personal compliments" wherever possible. Talk to each official and enquire about their personal welfare. "Avoid over work towards the end of the day". If the job is big "distribute" it in parcel.

To promote progress in the organisation, and to keep the tempo of work done, motivate the employees by proper incentives as and when required. In order to make administration effective and efficient implementation of the psychological principles is inevitable. Thus psychology helps efficient administration.

### Uses of Psychology

The definitions and the applied branches of psychology

make it clear that the study of human mind and behaviour has a lot of utility value. Its uses are as many as there are human activities. Some of the important uses of psychology are :

(1) The study of psychology helps us to understand ourselves and others. Thereby it helps to adjust mutually and harmoniously. In short, it promotes harmonious social relation and adjustment.

(2) The knowledge of educational psychology helps to choose the courses of study that suits his aptitude. Intelligence, interest and personality, so that he will be successful in the course of his choice. The psychological tests come in handy to select the students for various professional courses which demand certain abilities, interest and intelligence on the part of the student. Psychology offers the effective and efficient methods of learning and remembering. Further, psychology offers the technique of analysing and solving the emotional, interpersonal, sexual and educational problems of students as well as teachers. It also helps to plan out special programmes for the gifted and the handicapped children.

(3) The psychological tests that are available in the field help selection and placement of employees in a large organization. Nevertheless they are used for vocational guidance. If guidance and selection are made strictly, a great deal of unhappiness of the employees by placing wrongly can be overcome. Industrial psychology tries to solve various industrial problems like industrial unrest, industrial morale, human relation in industry, effective incentive system, fatigue, accidents, absenteeism and work environment. Human engineering which is a specialised branch helps to fit man and machine together in such a way that both should function with maximum efficiency.

(4) the knowledge of social psychology helps to socialize the individual in the way the society demands. The public opinion assessed with reference to a particular issue of public interest, guides the government to plan out its policies and measures in the way it is suited to a large majority. A proper and effective propaganda technique can be availed of to shape or to change the public opinion about the burning problem of

the state or the country as desired by government. Nevertheless it helps to solve the antisocial problems like crime and juvenile delinquency and racial or religious or caste prejudices which are hindrance to harmonious social relations.

Today the world is confronted with the problems of population explosion; nuclear war; rapid growth of unemployment and rampant mental illness which are threatening the survival of mankind. To analyse these problems, in a dispassionate way and to find lasting solutions to these problems, the knowledge of psychology is very essential.

(5) The knowledge of abnormal psychology helps us to dispel the wrong notions about abnormality and made us to understand that mental illness is due to unresolved conflicts, unbearable frustrations and pressures from within and outside. Thus it has led us to look upon the unfortunate mental patients with kindness, compassion, sympathy and understanding and to provide them necessary treatment instead of cruel treatment meted out to them. Whereas therapeutic methods and techniques developed by clinical psychologists are very effective in alleviating the sufferings of various types of mental patients. The principles of mental health help to prevent the onset of abnormality, to cure if they occur and to maintain good mental health.

(6) Psychological tests are used in the army for selection, grading and promotion of army personnel. The tests are also used to spot out the problem cases who are dangerous to the army. Social psychological principles are used to maintain the morale of one's own army and civilians, and at the same time to destroy the morale of the enemy. Thus psychology is useful in every walk of human life.

(7) Consequent on the increase in the life span of the individual the population of old people is increasing and causing a serious and urgent problem to every society and government. The problems of adjustment and rehabilitation of the senescents need the knowledge of psychology.

## METHODS OF PSYCHOLOGY

Just as any other science, psychology also has developed its own methods. Methods are always developed according to its needs. These methods are not mutually exclusive. As the scope of psychology has widened, new methods have come into existence. Particularly, as psychology became one of the sciences more accurate scientific methods of experimentation and measurement are developed. Thus psychology started using measurements and statistics to collect, to analyse, to classify, to verify and to interpret the data obtained from investigations. Some of the important methods used in psychology are;-(1) Introspection, (2) Objective or naturalistic observation, (3) Case study method, (4) Field investigation or survey method, (5) Experimental method or laboratory observation

### (1) Method of Introspection :

The method of introspection was suggested, perfected and made more scientific and accurate by Edward Bradford Titchener. According to him psychology must deal only with the inner states of consciousness in order to find out its structure. Introspection means looking within or to look into one's ownself, i.e., one's own thoughts, feelings and

experiences at the time of living through the experiences in a given situation, at the given time, and to a given stimulus. Here attention of the individual will be directed inwards to a particular experience and with a particular purpose to find out what exactly is happening in mind and in a given situation. Here either the psychologist himself looks into one's own mind or he may ask his subject to look into himself and to report the working of his mind while undergoing a particular experience. In order to obtain accurate report of one's own experiences the subject will have to be given intense training. If this method is strictly followed, it provides most valuable data to study psychology of an individual and to predict his behaviour. The data obtained from this method cannot be obtained by any other method. Unfortunately one cannot look into one's ownself and live through his experiences simultaneously. The moment an attempt is made to look into one's own experiences the experiences cease to exist or fail to continue. For e.g., when an individual is laughing at a joke if an attempt is made by him to observe one's own experiences, laughter disappears. So the subject has to look back to know the experiences he had. In that case it becomes more a retrospection than introspection. So the method can rightly be called the method of *retrospection* and not *introspection*. However, this method is still known as the method of introspection. If we trace back to the history of psychology we find that several valuable principles regarding the working of the human mind have been discovered through this method. It is by this method that one's mental setup can really be studied.

#### **Objections and Limitations :**

Several Objections are raised against the method of introspection by later psychologists. Some of them are :

(1) As pointed out already, it is not possible to observe ones ownself and at the same time to live through the experience. If an attempt is made the experience disappears. So one has to depend upon immediate memory to recall and to report the experiences he had. As memory is subjected to omissions and commissions, it affects the scientific value of the method.

(2) The results of the introspective method are only subjective and hence they lack scientific validity. If one depends on introspective data, it cannot be verified rather it is to be accepted on the face value, without questioning.

(3) This method cannot be used to study children animals, insane people, feeble minded and those who are not good at verbal expression.

(4) Experience being unique, it cannot be repeated time and again.

(5) Many activities of man are partly or wholly unconscious and cannot be observed and recalled consciously.

(6) All the experiences and feelings cannot be verbalised and hence if an attempt is made it will be distorted.

Some psychologists especially behaviourists headed by Watson seriously questioned the status of introspection in the science of psychology. Infact, he has made a dogmatic statement that—"psychology can never be called a science and cannot come up to the level of physical sciences until it discards the use of the terms like feeling and instincts, and discards the use of introspection in the study of psychology."

Despite the objections and limitations, this method is inevitable in psychology as long as it deals with experiences and feelings. Though the data is subjective, it can be made objective by proper training and by supplementing objective observation. Even when we use the experimental method introspection can be very gainfully used to obtain supplementary data.

## (2) Naturalistic observation

In order to overcome the limitations of introspective method, naturalistic observation method came into existence. In this method attention is focussed not on self-experience and conscious state, but on the gesture, behaviour, social adaptation and bodily changes of other people. The observer, observes the behaviour of different people in a given situation or same people under different situations, or different people in different situations according to prearranged schedule i.e., whom to observe, what to observe, how to observe, where

to observe and how long to observe, and records the details verbatim. The data thus collected will be statistically analysed and interpreted. This can be verified by any other psychologist and if it stands the test of verification, the hypothesis postulated from observation will be retained. If it does not stand the test of verification, it will be rejected and a new hypothesis will be formulated.

The scientific observation is made under controlled conditions, so that the influencing factors can be eliminated or retained if necessary. Observation is made according to the description of the conditions or according to the schedule, so that others can repeat them under similar or varied conditions and the result obtained may be compared with the original results.

The observer generally observes the behaviour of the subjects at home, on playgrounds, in class room, and offices or working places, in such a way, that they will not be knowing that somebody is watching their behaviour. The observer will make necessary arrangements to record the data observed, either by using tape recorder or vedio camera or a stenographer or sometimes the combination of two or three facilities that are at his disposal.

This method is generally used to study the behaviour of animals, children, abnormal persons and groups of individuals. Generally the data collected will be more accurate, objective and scientific than case history method. This does not mean that this method is free from flaws.

#### **Demerits of observation method**

1) In the method of observation, the observer has to wait for the behaviour under study to occur on its own accord. This naturally consumes a lot of time of the observer. Sometimes it may not occur at all, and in that case waiting will be a waste.

2) In the method of observation the observer can observe and record only the overt behaviour and not the feelings and experiences which are purely internal. Ignoring these feelings and experiences which underlie the overt behaviour, the data thus collected will be inadequate and incomplete. It will not serve the purpose completely.

(3) In the natural setting in which the observation of the behaviour is made, it will be impossible to control all the variables which determine the behaviour under study. Hence it will be very difficult to correlate the specific behaviour with the specific variable or factor.

(4) However much the observer tries to be objective in his observation and recording, personal bias somehow creeps into it, in the sense the observer will observe what he wants and not what is there.

In spite of these demerits, the method of observation is useful in the study of scientific psychology.

### (3) Case study or case history method :

Case study method implies a detailed study of the children or patients or individuals over a limited period of time. A case history is a detailed description of a particular individual. It is based on careful observation or formal psychological testing.

Careful case study includes an account of the child's family, social environment, his physical condition and history of development, his educational and economical experiences, his present habits, adjustment, satisfaction and anything that will increase insight into the persons behaviour. Case study will be made by a well trained, educated, social psychological worker or clinical psychologist, who has an impartial and objective point of view. Data will be collected from the records available, from parents, teachers and associates of the patients etc. In addition to the above sources of data, observations, interviews, questionnaires, tests and measurements are also used to supplement the information. After collecting information from all the sources, detailed case history will be prepared, analysed and interpreted. In fact Case history produces more detailed picture of an individual than any other method.

This method is used to study abnormal and antisocial behaviour like neuroses, psychoses, delinquency, crime etc. Hence this method may be called the clinical method. (1) The limitations are—as the part of data is collected from memory of the friends, parents, teachers etc., it is subjected to omissions and commissions. (2) Further this method being individual

method, it consumes a lot of time to collect data from a large number of individuals for study. (3) As it focuses on individuals, generalization about human behaviour is very much limited. Still case histories are very useful if data is collected carefully and objectively.

#### **(4) Survey or Field investigation method :**

In recent years, the application of psychological principles to various aspects of life is increasing. So it is necessary to collect data from large groups of people about various aspects like, attitudes, beliefs, prejudices etc. Such a necessity often arises in social psychology. To collect such data various methods known as interviews, questionnaires, rating scales, etc., are used. In educational psychology also field investigation method is widely used. Statistics will be used to select the sample, to administer the test, to analyse the data and to interpret the results. The advantage of this method is that the data can be collected from a large number simultaneously. The draw back of this method is that the experimenter has to accept the answers given by the subjects without questioning. However, this method is very useful even today because if  $N$  is large it takes care of false answer.

#### **(5) Experimental or Laboratory Observation method**

The essence of an experiment in psychology consists of controlling the conditions under which the behaviour occurs. After controlling all the possible variables, only one variable will be varied systematically and the consequent behavioural changes if any will be recorded. In short, the method of experimentation is nothing but observation of the behaviour under controlled condition. Here the experimenter will not wait for the behaviour to occur in nature, rather the behaviour to be studied will be produced "at will" by creating an appropriate situation and by presenting a stimulus, to an organism. The consequent behaviour that occurs will be correlated with the stimulus. From this it is possible to predict the nature and type of response or responses which may occur to a given stimulus.

The essence of an experiment is that it can be repeated at will. It enables the observation being made under varying conditions. In an experiment the investigator arranges the experimental situation in such a way that certain factors are kept constant and one or two factors are varied. Thus the experimenter will have a perfect control of the whole situation. Every experiment will have two groups of subjects :— (1) controlled group and (2) an experimental group. Both the groups must be matched groups, in the sense, they must be similar in all respects. Generally the matched groups will have identical twins. Of the two groups mentioned above the controlled group will not be exposed to any experimental variation, but will be held constant. Whereas the experimental group will be exposed to some variable and the behavioural changes if any will be noted and correlated with the varied factor. In short the change in the response of the experimental group is considered to be due to the variable factor. If the matched groups are not available the experiment will be conducted only on one group under two conditions viz. (1) controlled condition and (2) experimental condition. Under controlled condition there will be no change, whereas under experimental condition there will be a predetermined change in the stimulus situation. The consequent change if any in the response mechanism under experimental condition will be considered to be due to variation in the stimulus situation.

The success of the experiment depends upon the following factors : (1) The nature of the organism. It means, whether the subject is man or woman or child or animal, on whom the experiment is conducted. (2) The present condition of the organism or the subject, at the time of conducting the experiment. Ex: hungry, angry, happy or sorrowful moods. These organic states of the subject have their influence on the response. (3) The nature of the stimulus. It refers to the kind of stimulus used in the experiment, i.e., light, sound, food, water etc. It also refers to the duration and the intensity of the stimulus presented. If these preconditions are satisfied the experiment conducted will be definitely more objective, dependable and scientific.

Every experiment involves two individuals—one, the experimenter (E) and another the subject (S). The experimenter is one who gives the experiment or the test, whereas the subject is one who takes the experiment (e). Further every experiment will have a stimulus (s) and a response (r). The stimulus may be, physical like light, sound etc., or social like the customs, traditions, values, individuals etc., or psychological like thought emotion etc. Whatever be its nature it elicits a response or provokes a response in the organism or the subject, whereas the response is the reaction to a stimulus. The response may be motor or glandular in nature. Whatever be its nature, its purpose is to help the organism to adjust to its environment.

Thus every experiment requires an experimenter and a subject, stimulus and response, controlled group and experimental group or controlled condition, and experimental condition, tests and apparatus to conduct the experiment.

### **Merits of the experimental method**

Every method has its own merits and demerits. So also the experimental method. Some of the merits are :

(1) The results obtained from this method are precise, exact and quantitative.

(2) The results can be verified by repeating the experiment under similar condition at any time later and can be either accepted or rejected.

(3) A number of factors which are likely to affect behaviour can be controlled or the influence of those factors can be minimised at will and only one factor can be varied at a time.

(4) Unlike the method of observation, the experimenter, here need not wait for the behaviour under study to occur in nature, rather it can be produced at will under appropriate situation and by presenting a stimulus.

### **Demerits**

(1) However much the experimenter tries to make the experimental situation equal to the natural one the situation still remains artificial. Hence, the responses obtained or elicited by appropriate stimulus, will not be the same as natural ones.

(2) It is very difficult to find matched groups for the study.

(3) All the factors which are likely to affect the response cannot be completely controlled or eliminated. Hence it is difficult to correlate the stimulus and the response with each other with an accuracy of cent per cent.

(4) All the behaviour cannot be experimented upon.

In spite of these demerits this method is considered to be the best. It is only through this method psychology can become a science. Further, apart from the methods discussed above there are many more methods adopted by psychologists for study. The relative advantages of a method depends upon the subjects whom we study and the conditions prevailing.

## CHAPTER II

# Biological Basis of Behaviour

## Nervous System and Glands

Man does not live in vaccum. He lives in physical as well as in social environments. So long he lives in any environment he has to react appropriately to innumerable stimuli which are acting upon him every moment. Thus he has to adjust to the environment for his survival, otherwise he has to perish. So various psychological processes shown, are the functions, meant to help him to adjust to his environment. Every psychological function has a physical basis. The various structures which most directly underlie psychological processes are. (1) The 'nervous system' which interconnects receptors and effectors, comprises of the nerves, spinal cord and brain. (2) The 'sense organs' referred to as 'receptors' receive stimuli and provide information about the world around (3) 'Muscles and glands' referred to as effectors, respond to stimuli and help adjustment. Our aim here is not to know anatomy, physiology endocrinology and neurology but to know the biological basis of psychological processes like learning, memory, attention, perception, motivation, emotion and so on. Without under-

standing the relevant biological mechanisms underlying behaviour we are likely to have inaccurate picture of inner processes which lie in between the stimulus and response.

### The nervous system :

It is a mechanism by which the individual's behaviour is controlled, regulated, and organised into a harmonious unit. Sensory nerves carry the message from the sense organ via the spinal cord to the appropriate center of the central nervous system (cerebral cortex) and from there the motor nerves carry the orders to the motor organs or glands to react or respond to the environment in an appropriate way or ways, so that the individual can adjust effectively and efficiently. The nervous system is broadly classified into two divisions : (1) central nervous system (2) peripheral nervous system. The central 'nervous system' includes the brain and the spinal cord. The brain includes cerebrum, thalamus, hypothalamus, medulla, spinal cord and the cerebellum. Whereas peripheral nervous system includes, receptor nerves and effector nerves. This classification is not a water tight compartment, but a better terminology to deal with

Man has a number of sense organs, such as eyes, ears, nose, tongue, skin, static sense organ or vestibular organ, etc. These organs have 'receptors' of specific nature. These receptors depending upon the sense organ to which they belong receive the specific stimulus from the environment around. For example the receptors in the eyes receive the stimulus 'light' and ears receive 'sound'. The 'receptor nerves or sensory nerves which are connected with the receptors of sense organ, carry the message caused by stimulation, to the centre via the spinal cord. Sometimes they carry the message only to the spinal cord and the individual becomes aware of the situation. Then the centre sends the orders to the muscles or to the glands through motor nerves or effector nerves to show appropriate response. In this way nervous system has an arrangement to collect the information from the external world through sense organs and to react appropriately through motor organs. Thus every action of the individual is controlled, regulated and directed by the central systems

## Characteristics of the nervous system :-

The nervous system has some special characteristic features in its functions. Some of them are :

(1) Nervous system is compared to telephone system in which if a particular number is dialed only the concerned receiver at the other end starts ringing until the person lifts the receiver. In reality the nervous system is not exactly like telephone system, rather it works like exchange controller, in the sense it receives the stimulus and communicates it to the concerned center of the brain. The orders of the centre will be communicated to the concerned motor organ and if it is not in a position to respond, another motor organ will be directed to take action. Example : when a person is confronted with a mad dog, the sight of it will be communicated to the visual area of the cortex. Then the message will be communicated to association and motor areas. Depending upon the past experience, the legs may be ordered through motor nerves to run away or summon courage to kill the dog. So different organs will be communicated by the centre to take appropriate action, and thus there is always a choice in action.

(2) Apart from choice in action there is also provision for 'set action' in the nervous system. The set actions are known as 'reflex actions'. These reflex actions need no preparation or readiness. They take place automatically in a stereotyped way. They are innate and unlearnt. For ex : winking, sneezing, Babinsky reflex etc. (Zubek J.P. and Solberg P.A. (1954).

(3) There is provision in the nervous system for 'selection of the stimulus and selection of the response', in the sense the nerves have the capacity either to inhibit or to release the nerve impulses or message depending upon the strength or the importance of the stimulus and the circumstance. Ex : A loud and a mild sound if presented simultaneously, the former will be attended to and the impulses will be released, whereas the impulses released by mild sound will be inhibited and un heard. Thus we find some special characteristics in the functioning of nervous system.

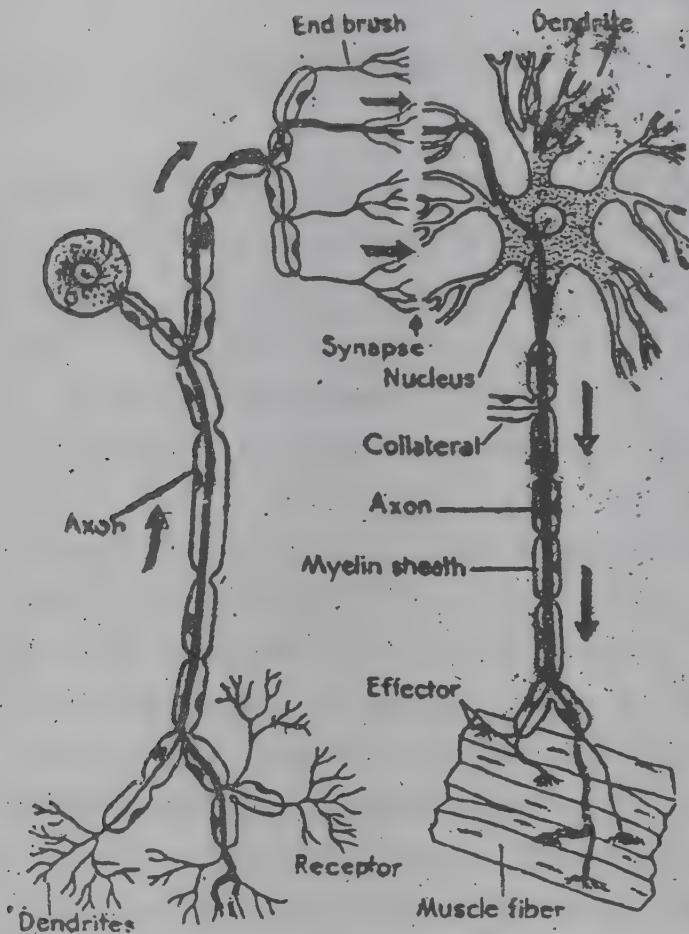


Figure : 3 structure of a neuron and synapse (Munn)

### Neuron :

The nerve is not a long string like structure which connects the sense organ at one end and motor organ at the other end, rather it consists of a number of nerve fibres. Most fibres are in bundles, like wires in a cable packed together tightly and insulated by a whitish fatty covering known as 'Medullary or myeline sheath. The major purpose of this covering is to prevent signals

from adjacent cells from interfering with each other. Myeline sheath is divided into segments and makes it look like a string of sausages. Because of this, neural impulses "hop" from one break to the other. This helps impulses to travel faster. Thicker the sheath faster the impulses travel. Nerve impulses travel more slowly in babies, than in older children and adults because myeline sheaths have not fully developed in babies. The optic nerve for example is estimated to have 4,00,000 fibres. Thus the nerve consists of innumerable minute fibres. The unit of a nerve fibre is known as 'neuron.' Each neuron has a 'cell body', a number of a projections known as 'dendrites' and an 'axon.' These structures are found both in the sensory and motor neurons. Each neuron has many dendrites which are short and an axon which is long. At the far end of the axon there is an end brush. Dendrites carry impulses towards the cell body and axon carries away from it. the axon conducts the communication (neural impulses) either the muscles or

to the spinal cord or to the dendrites of the next neuron depending upon the distance between the sense organ and the spinal cord or between the spinal cord and the motor organ. The maximum length of a neuron is about six inches. Sometimes an axon varies in length from  $1/10$  of mm to a few feet. So the number of neurons lying between the sense organ and the spinal cord or between spinal cord and motor organ vary in number. "The cell body" is shaped like a sphere or a pyramid. It contains biochemical machinery for keeping neuron alive. It determines whether these neuron should fire or transmit message to other neurons.

The neurons which are connected to 'receptors' are known as 'receptor neurons'. As they have sensory functions they are called 'afferent neurons' and their function is input. Afferent dendrites convey impulses to the cellbody and from there, impulses are relayed to the next neuron by the axon. The neurons connected with motor organ or gland are called 'motor neurons.' As they have motor functions they are called 'efferent neurons.' Their function is 'only out put'. They carry impulses to the muscles or glands to react.

### Synapse :

The synapse is an extremely important concept in understanding the nervous system. The kind of contact established between the axon of one neuron and the dendrites of another neuron is interesting and significant. Two neurons establish contact very close to each other, but never grow together rather they remain separate. This type of connection only by contact as and when required is known as 'synaptic connection. The point of contact is called 'synapse' or the gap between the axon of one neuron and the dendrites of another neuron is known as synapse. In other words 'the junction where the nerve impulses pass on from one neuron to another is known as synapse. The synaptic gaps are 500 times thinner than the finest hair. It permits each neuron to communicate with hundreds and thousands of other cells. So the number of communication links among neurons is in trillions or even quadrillions. The axon is said to be the conductor and

stimulator whereas the dendrites are said to be receivers. The connection between the neurons, only by contact is very essential for the flow of 'electro chemical waves' or 'neural impulses' which are discharged when the receptors are stimulated.

As the neurons are not connected together, the axon of one neuron can establish synaptic connection with several other neurons. A single neuron can receive stimuli from the axons of several other neurons. That is why we notice a combination of varied stimuli and a combination of varied responses in a single neuron, branching and stimulating several other neurons. Here we find the principle of selectivity in forming synaptic connections. Some neural impulses are inhibited and some other impulses are facilitated. Thus the nerve connections are extremely intricated and highly organized to help the organism adjust to the complex environment and to survive.

#### **Nerve Impulse :**

Every sense organ has a number of receptors. Each receptor is stored with energy. When they are stimulated by a stimulus or stimuli, they release the energy stored in the fibres. This energy is known as 'neural impulses' or electrochemical waves. The energy is again restored soon after it has been used. So the nerve fibres can be activated again and again.

It is stated that neurons speak to one another or in some cases to muscles or glands in an electrical and chemical language. Electrochemical waves are capable of arousing the muscles or the nerve centres to action. Any stimulus which is sufficiently strong enough, makes the nerve fibres to discharge the energy. This energy will be used to transmit the message. As said above, soon after exhaustion of the energy, the nerve fibres will be restored with energy for further discharge. The interval between passage of an impulse and its recovery is known as the 'absolute refractory period.' This interval differs from fibres to fibres. The shortest duration is about  $1/1000$  of a second. (Munn, 1966),

It is said that a weak stimulus may not stimulate the nerve

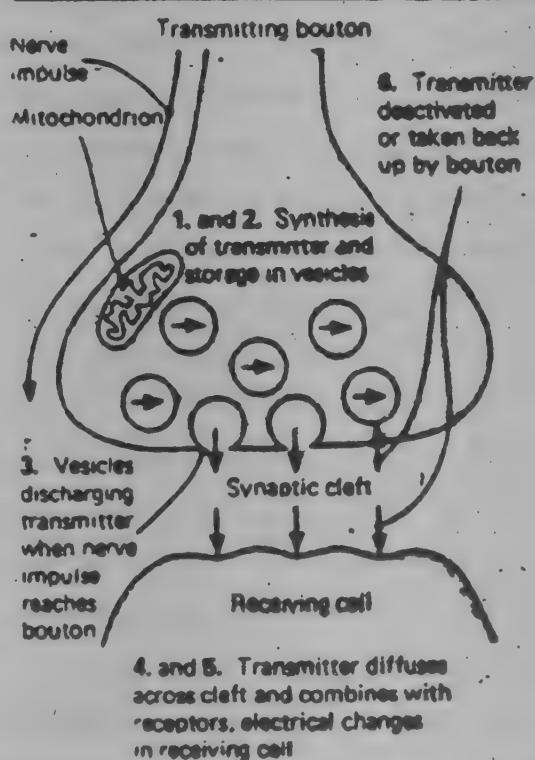
fibres to discharge the energy and to provoke a response, whereas a stronger stimulus makes the fibres to discharge the energy and provokes a response. Thus depending upon the strength of the stimulus there may be a response or no response. This is known as 'all-or-none' law. Another significant law is that a stronger stimulus produces a stronger response by arousing more number of nerve and muscle fibres and thereby discharging more impulses per second. The frequency of impulses per second also increases. Thus we find 'the stimulus and response are proportional to each other'. In other words there is graded intensity in stimulus-response ratio. It is also observed that the neural impulses travel at the rate of 120 yards per second. That is the reason why both the stimulus and response seem to occur almost simultaneously (Munn, 1966.)

### Neurotransmitters :

Neurochemists and pharmacologists have identified a number of chemical substances, which act as neurotransmitters at the point of synapse of the nervous system and at the function between nerves and muscles i.e. neuromuscular function.

Infact a number of steps are involved in chemical transmission of information across synapses, from one neuron to another neuron.

Steps in the chemical transmission of information across a synapse.



1. Transmitting (presynaptic) neuron manufactures or synthesises, the neurotransmitter molecules from simpler molecules derived from the food we eat and other sources.

2. The manufactured neurotransmitter is stored in the bouton vesicles of the transmitting neuron.
3. 'Nerve impulses reaching the boutons initiate a process which causes some of the vesicles to move to the synoptic cleft. There they discharge the stored neurotransmitter.
4. The neurotransmitter rapidly diffuses across the narrow synoptic cleft and combines specialised receptor molecules on the membrane of the receiving or postsynaptic neuron.
5. The combination of neurotransmitter and receptor initiates change in the receiving neuron, which lead to excitation or inhibition.
6. The combined neurotransmitter is rapidly deactivated to make the post-synaptic cell ready to receive another message.

One of the methods of deactivation is by catalysts called "enzymes." These catalysts trigger chemical reactions, which breakup the neurotransmitter molecules.

Another way of deactivation is by the process of "reuptake." In reuptake the transmitting boutons take back the released neurotransmitter and store it in vesicles for use at another time. Inshort the stages in synoptic transmission are—neurotransmitter manufacturing, storing, releasing, diffusing, combining with the receptor, and deactivation.

A few "Neurotransmitters" and "location" of action are—

- 1) Serotonin or 5-hydroxytryptamine → Nervous system.
- 2) Glutamic acid → Nervous system
- 3) Endorphins → Nervous system.
- 4) Vasopressin → Nervous system & pituitary gland

The Neurotransmitters make a neuron to excite and inhibit another. A dozen of substances are known as transmitters. They play critical roles in affecting moods memory, and psychological well being. Neurotransmitter imbalances cause severe mental disturbances such as—schizophrenia and extreme depression. The neurotransmitter deficiency helps to explain the onset of Alzheimer's disease which is popularly known as "*Premature senility*" because it occurs in young and middle aged adults. This disease causes—loss of memory,

changes in personality, and disintegration of all physical and mental abilities.

One group of neurotransmitters are known as "endorphins." There are three kinds of endorphins—a) endorphins proper, b) enkephalins, c) dynorphins. These three differ in chemical structure and distribution in nervous system. "Endorphins" resemble natural opiates like heroin and morphine. Endorphins relieve pain by preventing pain signals from spinal cord to brain. The level of endorphin increases with exercise which is a form of stress. Acupuncture relieves pain by increasing endorphin level.

"Drugs" affect behaviour and experiences. They are called "psycho active drugs." These drugs generally work on the nervous system by influencing the flow of information across synopsis. Ex: They interfere with one or several stages in synoptic transmission. They also act like natural neurotransmitters and these excite or inhibit receiving cells. example—  
a) "LSD" (Lysergic acid diethylamide). This causes—distortions of perception, mood variation, etc.

b) "Marijuana" causes—Relaxation, calmness, and sharpening of perception etc. c) "Heroin" causes dreamy, warm, pleasant, euphoric feelings. d) "Barbiturates" cause drowsiness, euphoria and reduction in anxiety etc.

### **Receptor :**

As mentioned already each sense organ has hundreds of receptors. In some organs they are more and in some others they are less. The receptors of the respective organ receive the stimulus which belongs to that department. Ex : The receptors of the eye receive the stimulus 'light.' The receptors of the ear receive the stimulus 'sound'. After receiving the stimulus, they discharge the neural impulses in proportion to the magnitude of the stimulus and transmit the same through sensory nerves either to the spinal cord or to the brain through the spinal cord. Thus they provide us the knowledge of the world around.

### **Effectors :**

The effectors are the muscles and glands. They act upon the environment as directed by the spinal cord or the brain.

Thus with the help of these, the organism react to the internal as well as to the external environment and adjusts to it.

### Reflex Action :

A reflex action is a direct muscular or glandular response to a sensory stimulus. This is an unlearnt, involuntary, stereotyped and quick reaction but not a response to a sensory stimulus. It requires no readiness and does not alter or change with experience. Being innate it is found with all the members of a species. It takes place automatically without any deliberation, and it has survival value to the organism. Some of the reflex actions are: 'Startling' at a sudden loud sound, "winking" when dust falls into the eye or at sudden flash or light, 'pupillary reflex' Knee jerk reflex, 'Babinsky reflex', salivary reflex, and so on. Any reflex action involves (a) sensory nerve. (b) motor nerve and (c) a bit of spinal cord. Reflex action takes place at the spinal level and not at the level of cortex. (Zubek and Solberg 1954).

### Reflex arc :

A Reflex arc is a pathway from sense organ through the spinal cord to muscles or glands. It involves a sensory neuron, a motor neuron and a bit of spinal cord. In reflex action a definite connection is laid down between the incoming sensory fibres and outgoing motor fibres via the spinal cord, Ex. knee jerk.

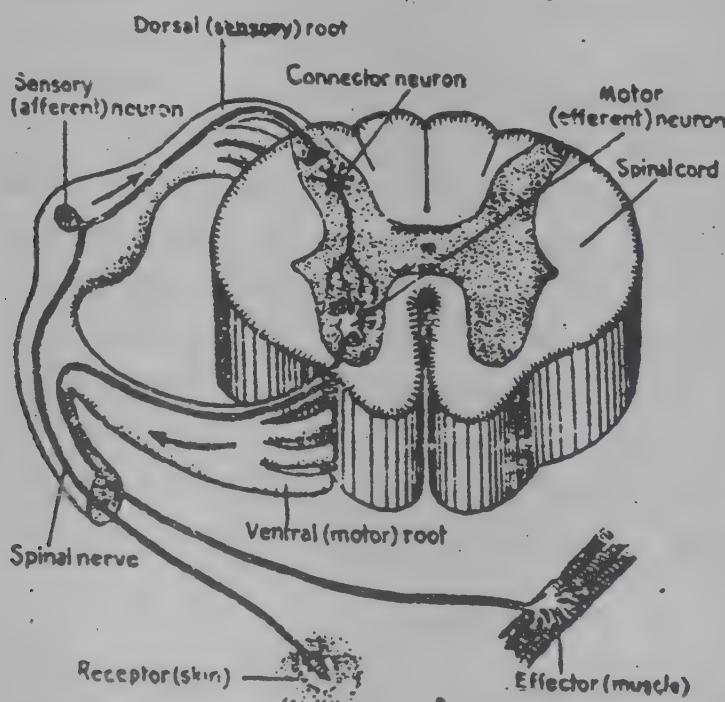


Fig. 3. Reflex arc (Mun N.L. 1966)

The diagram reveals that a sensory axon leading from the receptors to spinal cord and forming a synoptic connection with motor neuron whose axon extends to the muscles. The combination of a sensory and a motor neurons constitute two neurons reflex

arc but a large majority of reflex arcs have at least three neurons and a few require even more. The reflex arc is nothing to do with the cortex in its function. In some cases it is more complex. The neural circuits underlying spinal reflexes are linked to other neural pathways that run up and down the spinal cord to and from the brain. Because of these connections the reflexes which do not require conscious awareness can sometimes be influenced by thoughts and emotions. Example: erection in men, a spinal reflex can be inhibited by anxiety or distracting thoughts and initiated by erotic thoughts.

### **Peripheral Nervous System**

All those nerves which go out from the spinal cord and the brain to various internal as well as external organs of the individual and back to spinal cord and brain from various parts of the body constitute the peripheral nervous system. They are broadly classified into two divisions (1) Cerebrospinal nerves (2) Autonomic nervous system.

(1) 'Cerebrospinal nerves' carry impulses initiated by external or internal stimuli to central nervous system and convey impulses released by the central nervous system back to peripheral organs of response. These nerves are further subdivided into—(a) Cranial nerves and, (b) spinal nerves. (a) There are twelve pairs of 'cranial nerves'. They are attached to the lower level of the brain directly. The nerves concerned with smell, taste, sight, hearing and those which serve the skin of the face belong to this group. (b) 'spinal nerves': There are thirty one pairs of spinal nerves attached to spinal cord. They are classified according to the body region to which they innervate. Each nerve has two roots—a 'dorsal' and a 'ventral' root. The dorsal root has sensory fibre, which goes towards the back carrying sensory impulses and the ventral root has motor fibre which goes towards the belly carrying motor impulses. If dorsal fibres are cut off, man loses sensitivity in that part of the body connected with them. If ventral fibres are cut off the connected part of the body would be paralyzed. In polio ventral fibres are destroyed and hence

paralysis of corresponding part of the body occurs. Apart from this in a simple reflex action, impulses will be conducted through sensory fibres to the cord and thereby through motor fibres to the muscles without any contact with the brain.

### Peripheral Autonomic Nervous System

This subdivision of peripheral nervous system is called so because both in structure and function it is more or less autonomous. It carries on its functions for the most part automatically, without any internal control and without arousing in us clear awareness of the activities involved. Most of its connections are with organs of the abdomen, known as 'visceral organs'.

Autonomic nervous system is further subdivided into two parts—(1) Sympathetic nervous system and (2) Parasympathetic nervous system.

(1) **Sympathetic nervous system** :—Sympathetic nerves descend one on each side of the spinal cord intermittently. They are connected with heart, lungs, glands, stomach, intestine, blood vessels, excretory organs etc. This system is very much involved in emotional behaviour. This prepares the body for expenditure of energy. It acts like accelerator of a car mobilizing the body for action and an output of energy. It acts upon various organs connected with it. Either it accelerates or slows down their functions. For e. g. It accelerates the functions of heart, lungs, and some glands (adrenal gland) and slows down the functions of stomach, intestine and excretory organs. That is the reason why the individual is advised not to become emotional after taking food. Apart from the above changes there will be vasodilation, enlargement of pupil, increased, blood sugar etc., under emotion.

### 2. Parasympathetic nervous system :

This subdivision branches out from the cranial region of the brain and lower segment of the spinal cord. This is further divided into (a) vagus nerves, and (b) pelvic 'nerves. The vagus nerves' descend from the brain control heart, lungs, stomach, intestines and pancreas. The 'pelvic' nerves descend from the sacral region of the spinal cord and control large bowel,

rectum, bladder and sex organs. Parasympathetic nervous system helps normal functions of the above organs under normal conditions. In the sense it promotes normal circulation respiration, digestion and elimination.

Though the sympathetic and parasympathetic divisions are the branches of autonomic nervous system, they are opposed to each other in their functions. In the sense the former division accelerates the functions of heart, lungs, glands and liver on the one hand slows down the functions, like digestion and elimination on the other hand. The latter division brings down all the functions to normalcy. This antagonistic nature is very important to provide a stable autonomic equilibrium to the body.

Apart from peripheral autonomic nervous system, which sends impulses to and from central nervous system, there are also higher autonomic centres, located in medulla, cerebrum etc., Hypothalamus governs both the divisions. Autonomic nervous system helps bodily functions under normal and abnormal conditions through sympathetic and parasympathetic nerves. This hypothalamus is governed by cortex. So mere unpleasant thoughts bringss out changes in the bodily functions.

## CENTRAL NERVOUS SYSTEM

Central nervous system is responsible for processing, interpreting, and storing in coming sensory information-about sounds, smells, colours, pressures in the skin, the state of internal organs and so on. It also sends out orders to muscles, glands, and bodily organs. The central nervous system consists of Spinal cord, Medulla, Thalamus, Hypothalamus, Cerebellum and Cerebrum. The human brain is estimated to contain about  $10^{11}$  neurons i.e. one hundred billion cells (100,000,000,000), about the same as the number of stars in our galaxy.

### 1. Spinal cord :

Spinal cord is the earliest evolved structure in the central nervous system. It is found only in the vertebrate animals. The nerve clusters have developed into spinal cord. The cord

runs along the centre of the vertebral column and is well protected by bony case through which it runs. The centre of the spinal cord has a butterfly shaped mass of 'gray matter'. It contains association neurons and the cell bodies of efferent neurons. The outer surface has 'white matter'. It is whitish because the fibres within are covered by a white fatty sheath.

It forms the channel for all messages from the sense organs to brain and back to the muscles. Spinal cord is not

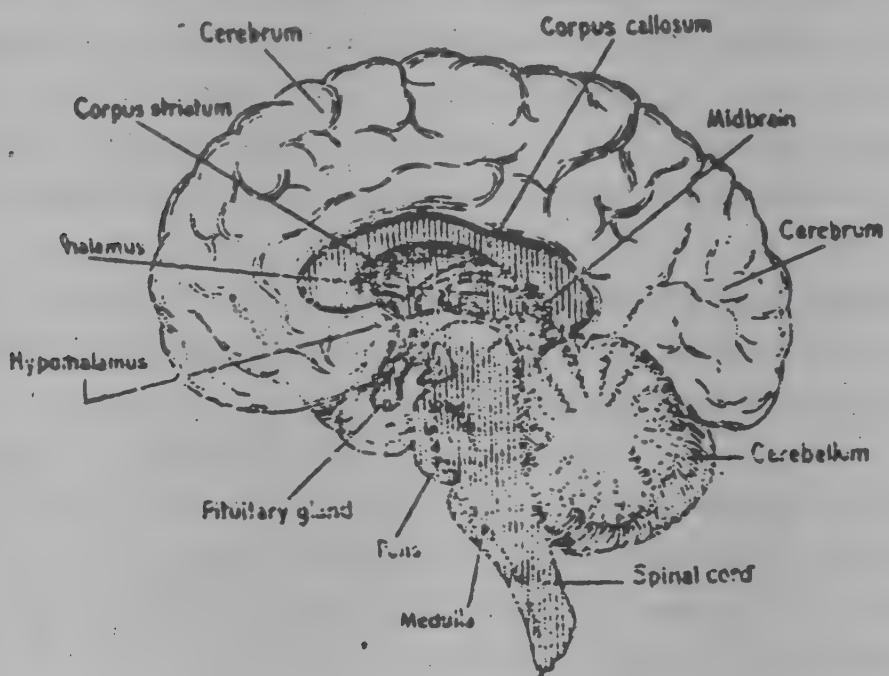


Fig. 4 Parts of Central Nervous System [Munn, N.L. 1966]

merely a bridge between brain and the parts of the body below the neck but also produces some behaviour, called reflexes without the help of brain which is discussed already. Injury to the spinal cord may result in loss of sensitivity in the concerned part of the body or may cause paralysis of that part of the body which is connected with the damaged part of spinal cord. Sometimes death may occur depending upon the seriousness of the injury to the spinal cord.

## (2) Medulla :

The upper part of the spinal cord has a bulb like structure called medulla or medulla oblongata. It is similar to the spinal cord in its functions. It is through this all the nerves from and to the brain pass through. It contains various centres

which control heart rate, circulation of blood and respiration. Thus it plays a very significant role in maintaining the survival of organism.

### 3. Thalamus :

Just above the medulla and at the bottom of the cerebral hemispheres there is a mass of gray matter called 'Thalamus'. It is a greek word meaning "Bedroom" It is the seat and centre of all experience. It is very important because all the nerve connections to the brain pass through it. It is not merely a channel but also a switch board which gives connections to the appropriate centres of the cerebral cortex, in the sense, impulses from the skin are directed to a particular part of the cerebrum and impulses from the eyes to another part of the cerebrum and so on. The thalamus also mediates simple form of learning. Thalamus is very important in lower animals because all the activities are controlled by this. In man because of the emergence of fully evolved cerebrum, many important functions are transferred to cerebral cortex,

### 4. Hypothalamus :

Just below the thalamus but connected to it, there is a small structure called 'hypothalamus'. As it is the seat of autonomic nervous system, all the activities of the sympathetic and parasympathetic nerves are controlled by it. So the activities like circulation, respiration, digestion and elimination are controlled and directed under normal as well as emotional conditions by this. It plays a very significant role in the emotional life and motivational functions of the organism. Apart from the above body metabolism, temperature regulation and sexual activities are controlled by this.

Both the thalamus and hypothalamus are together called 'Inter brain'. They together work like personal assistant to the chief officer. Apart from sending impulses and messages to the higher brain centres, they have frequent communications with higher brain centers, especially during emotional condition.

### 5. Pons :

Just above the medulla but below the midbrain there is another bulb like structure called 'pons'. It is a bridge

connecting the lobes of cerebellum with the opposite side of the cerebrum and the four lobes with each other. It is especially important in muscular co-ordination of various parts of the body.

#### 6. Midbrain :

Just above the pons but below the hypothalamus and thalamus midbrain is located. This structure is concerned with auditory and visual reflexes.

#### 7. Cerebellum :

It is at the back of the thalamic region and below the occipital lobe. The outer surface consists of gray matter and the inner surface consists of white matter. It co-ordinates reflex activities of various parts of the body like those involved in flying of birds, swimming of fish, walking of man and even speaking, writing, playing tennis etc..

The cerebellum is connected with pons and other parts of the brain stem. Ascending and descending pathways of the spinal cord are connected to this. The impulses are fed into this from two types of receptors—the static and kinesthetic. The 'static receptors' are located in nonauditory 'labyrinth' of the inner ear. They respond to changes in the position of the body. With the help of these impulses the cerebellum helps, to compensate for changes in position i. e. to maintain equilibrium. The 'kinesthetic receptors' form muscles, tendons and joints, indicate the changing activities of the muscles through out the body. This information is integrated in the cerebellum and in the associated mechanism. The impulses returning to the motor mechanisms initiate the proper reactions and appropriate sequences. In short it is concerned with kinesthetic and static activities. So if a man's cerebellum is seriously injured he is unable to walk normally. He shows jerks and unco-ordinated gait known as 'cerebelar atoxia'.

#### 8. Corpus striatum :

It is just below the cerebral hemispheres. Though it is not a part of the brain stem, it shows anatomical relation to the brain stem structures. Its functions are closely related to the functions of the cerebellum. It is complicated structure having several basal ganglia and pathways descending to the

brain stem from the motor areas of the cerebral cortex. If there is injury to corpus striatum it results in motor inco-ordinations like tremors and muscular rigidity.

### Old brain :

Medulla, pons, mid-brain, hypothalamus, thalamus and cerebellum are together known as 'old brain' or 'lower brain' 'brain stem', because, the new brain or higher brain is resting on the brain stem. This old brain is very important in the study of evolutionary developments of nervous system and the emergence of the new brain. Below the level of man the higher brain or cerebrum is less evolved structurally and is less important functionally. And hence the behaviour of the low level animals are controlled by the old brain. In man the cerebra hemispheres are fully developed and the behaviour is controlled by cerebral cortex. Thus the structures of the old brain are the boundary lines between man and animal,

### New brain (Cerebrum)

The climax of evolutionary product is cerebrum. It becomes larger and more elaborate as we go from rat to man. The cerebrum of man is larger than animal's cerebrum and also larger than all other parts of the nervous system put together. The surface of the cerebrum is not smooth because it has a large number of convolutions. These provide space for an increasing number of brain cells. These cells concentrate in the outer surface of the cerebrum and from the 'cerebral cortex'. The cortex is a grayish brain's bark. The human cortex is estimated to have fourteen billions of nerve cells. The gray matter is very essential for intellectual activities. The interior part of the cerebrum consists of white matter. Both the spinal cord and the brain are surrounded by cerebrospinal fluid and protected by it.

The cerebrum has two elaborately interconnected symmetrical halves called 'cerebral hemispheres'. These two hemispheres - the right and the left hemispheres are connected at the bottom by a mass of nerve fibres known as 'corpus callosum'. The right hemisphere controls the left portion of the body and the left hemisphere controls the right portion of the body. The millions of nerve fibres of the cerebrum

are classified into three groups depending upon their functions. (1) Association fibres which give connection to different areas within one hemisphere. (2) Commissural fibres give connections from one hemisphere to the other. (3) Projection fibres, start from central cortex and go down to the various lower centres and to spinal cord and back to the central cortex. These fibres are so well co-ordinated and interconnected that the whole brain acts as a single unit.

As said already, the upper surface of the cerebrum is not smooth, rather it has many convolutions. Some of them are so deep that they give the impression that the cerebrum is divided into parts. Such depressions are known as fissures. Of these fissures, two are very important from the point of view of anatomical divisions of the cerebrum (1) Fissure of rolandic or 'central fissure' and (2) 'Fissure of sylvius or lateral fissure'. The fissure of rolandic divides the two hemispheres from the top at the centre. The lateral fissure divides the hemispheres from the sides at bottom.

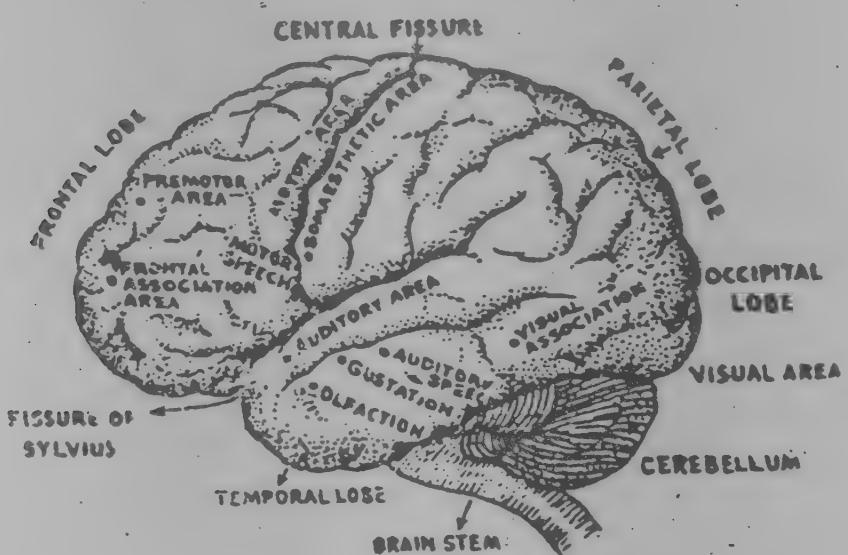


Figure 5. Cerebrum, Lobes and Functional areas  
(Sunder Das S. 1964)

Depending upon the differences in the cells and the structure, the cerebrum is divided into four anatomical areas known as (1) frontal lobe, (2) parietal lobe, (3) occipital lobe (4) temporal lobe. Each lobe has its identical areas in both the hemispheres.

1. **Frontal lobe** : Frontal lobe is in front of the brain.

Just at the back of it lies the fissure of Rolando. This lobe contains three important functional areas— (a) 'Motor area': it controls the voluntary movements of various parts of the body such as legs, arms, face etc. As this area spreads over two hemispheres, destruction of motor area of any one hemisphere causes paralysis of the muscles of the opposite side of the body. There may be recovery from paralysis, if it is caused by circulatory disorders—blood clot or haemorrhages. Sometime even if motor cells are irreparably destroyed, there may be some recovery, if appropriate training of the affected limbs is undertaken. (b) 'Premotor area' is in front of the motor area. It controls the complex and massive movements of the body as a whole, such as movements under dance, swimming, acrobats etc. (c) Association area is just below the premotor area. It is concerned with thinking, reasoning, learning of verbal and motor skills, memory and organizations of experiences into a coherent whole. Higher psychological processes depend upon this association area,

(1) **Parietal lobe**: This lobe lies at the back of the brain adjacent to the central fissure. Adjacent to the fissure lies the 'somesthetic' area. All the sensory impulses such as touch, cold, warmth, pain etc. coming from various parts of the body have their centres in this part of the lobe. If parts of the sensory area of the cortex are destroyed the individual loses the ability to experience sensations in the appropriate part of the body. Ex: If the cells which receive the impulses from the right hand are destroyed, the individual fails to experience pain in that part of the body.

(2) **Occipital lobe**: This lobe lies at the hind portion of the brain. Here lies the visual area. If this area is destroyed the individual loses sight. So perception of size, shape, colour, distance and depth, is controlled by this area.

(3) **Temporal lobe**: This lobe is located below the lateral fissure wherein lies the auditory area. It is concerned with perception of pitch, intensity, combination tones, timbre, direction and distance of the sound etc. If this area is stimulated electrically the individual hears all sorts of tones and

noises. Destruction of this area results in deafness. Just below this auditory area lies the 'gustatory area' which is concerned with sensations and experience of taste of various types. At one end of this lobe lies the 'olfactory area' which is concerned with smell. This lobe is more important than the frontal lobe. It plays a very important role in our emotional life. It is said that learning and memory ultimately depend upon this lobe.

#### Methods of studying localization of cerebral functions :

Gall, a phrenologist by crude and unscientific method located different functions at different parts of the brain. He located ; intellectual functions in the front portion of the brain, moral character in the mid-brain, instincts in the rear and sex drive in the cerebellum.

As the method adopted by Gall was crude and unscientific, Florance adopted—(a) 'extirpation method' in which a particular portion of the brain was destroyed or cut off in an animal and the effects of this operation was carefully studied. She found that loss of cerebellum. caused disturbance in animal posture and co-ordinated movements. Loss of brain stem caused disturbance in breathing, and circulation of blood. Loss of cerebrum causes loss in memory, understanding and initiative, etc. She also found that cerebrum functions as a whole. By the end of the 19th century there was a general agreement regarding the location of chief sensory areas (b) According to 'pathological method' disturbed functions were observed in patients whose brain was injured in some part and correlated the function with injured part. (c) According to 'electrical stimulation' method some weak current is applied to the exposed region of the cortex and the resultant responses are recorded. Thus each function was correlated with the respective part of the brain. (d) According to 'Fibre tracing method' the connection of certain parts of the cortex to the eyes, ears, nose, tongue etc, are traced by treating chemically. The pathway is traced by using microscope. This method is adopted only when the organism is dead (e) According to 'chemical method' different chemicals are applied to selected area on

The surface of the brain generally procaine is used as local anesthetic to produce temporary effects. Thus the function and the specific areas of the cortex are correlated. Though sensory motor functions are located by the above methods, no proper evidences are available regarding localization of memory, thinking, reasoning and feeling. Further studies in this line have revealed that learning and memory cannot be located to any specific area of the cortex. Instead, loss of learning ability depends upon the amount of cortex removed by operation. Larger is the amount of cortex removed greater is the loss in learning ability.

### The Two Hemispheres of the brain : (Split brain)

In a normal brain the two hemispheres communicate with each other through a mass of nerve fibres called "Corpus Callosum". Anything that happens in one side of the brain, will be instantaneously flashed to the other side, and hence the behaviour is well co-ordinated and smooth.

Though these are identical functional areas in both the hemispheres the "Left hemisphere" has an advantage in understanding language, formulating language for communication, and thinking with language symbols, whereas the "right hemisphere" is specialised to deal with mental images, spatial relationships and pattern recognition. This specialisation of hemispheres is only a matter of degree, but none of these abilities, can be located exclusively in one hemisphere or the other.

### Language and Left hemisphere :

If we observe people who are suffering from brain damage due to stroke to left hemisphere, they suffer from more serious language problem, than a stroke to right hemisphere. Stroke normally affects one side of the brain and produces paralysis of one side of the body. If one side of the brain has a stroke, the opposite side of the body will be paralysed and vice versa is also true.

Looking closely into the left hemisphere, we find that language functions are localized in the "upper temporal lobe"

and "lower frontal lobe". The language region in temporal lobe is known as "Wernickes area", because it is Carl Wernicke a German neurologist (1870) who traced this problem of upper temporal lobe. The language region in frontal lobe is known as "Broca's area". The language functions of this area was traced first by "Paul Brocas" a French physician (1860). Damage to one or the other area results in language problem, specific to the area damaged.

Wernick's area is concerned with understanding of spoken and written language. If this area is damaged, the patient develops the following problems—(1) impairment of the ability to repeat a spoken word ; (2) problems in reading and writing ; (3) difficulty in naming common objects ; (4) The intrusion of incorrect sounds or words into the flow of speech saying "repuceration". Example, he says "streeb" instead of "street" or says "daugther" instead of "mother".

The symptoms of the patient with damage to Broca's area are different. The spoken and written language is generally intact. He will have some minor problems in repetition and naming. The major difficulty is with fluency of speech. He speaks slowly and with great efforts articulates the sounds of speech poorly ; tends to omit pronouns, adjectives, verbs, and articles ; uses singular nouns and has great trouble with tenses of verbs. In short his speech is nonfluent and, ungrammatical. So 'Broca's pattern of speech is "telegraphic" in nature

The left brain is said to be—analytical, logical, mathematical and is concerned with cause-and-affect in scientific thinking. The right hemisphere is concerned with images, patterns of sensory input and synthesis of information. Its thinking is more concerned with creation of painting or musical composition. Some people are supposed to be "Left brained". They are normally scientists, accountants, physicians, and the like. "Right-brained" people are—artists, composers, architects and so on. Rarely individuals like Leonardo da Vinci may have both "left and right brained". Inshort we can say there is some hemispherical specialization in function. (Morgen and three others pp—69—73).

The human brain has adoptive mechanism. If left or right

hemisphere is surgically removed due to disease or injury, some surprising results have been noticed. The opposite side hemisphere gradually takes over the functions previously controlled by its counter part. Example—A boy aged 5 1/2 years was subjected to operation of left hemisphere. As this controls speech, it was assumed that he would never talk again. Surprisingly his speech and intelligence were stunted for a while but gradually increased after operation. He is now in his late twenties, leading a normal life and has an I.Q of 126. (Kotulak—1976).

If we carefully watch our skills, activities, learning at school, we can understand that society at large is "left hemisphere" dominated. So a large majority is right handed and left minded, and we all like to do what we do best. (Psychology an introduction—Charles G. Morris 1979)

## 2. Sense Organs

Sense organs constitute another physical basis of mental life. It is through sense organs we come in contact with the world around us. They are the gate ways for the world of knowledge. They are considered as the windows through which we see the world around. This knowledge helps us to react appropriately and to adjust to the environment. It is only when physical energy impinges on a receptor or sense organ behaviour occurs for example, a loud noise attracts our attention and makes us curious about its source. A painful sensation causes to look for remedy. A novel advertisement arouses our interest. In all these activities, one or more organs are involved. Some physical energy acts on the receptors and the receptors in turn discharge neural impulses, which will be transmitted by sensory nerves to the appropriate part of the brain and thus provide the knowledge of the environment. So the knowledge of the basic sensory processes is very essential to understand the behaviour of man.

In the past people believed that man has only five sense organs (panchendria)—eyes, ears, nose, tongue and skin. Now it is believed that we have some more sense organs, such as, static, organic and kinesthetic sense organs in addition to

thermal, pain, and pressure sense receptors of the skin. Each sense organ is important in its own way. The sense organs work in combination, rather than working independently. Some of them work so continuously that we will not be aware of them and some of them work as substitute to the missing organs. For example, the blind understands the world around to a great extent by ears, skin or nose.

Of all the sense organs eye is said to be the most important sense organ because of its frequent use. This sense organ in addition to providing knowledge of the world in its own way supplements the knowledge obtained by other sense organs. Example: while hearing the sound, we also try to see the object producing the sound. Now let us have a brief account of each sense organ.

### HUMAN EYE :

Human eye is compared to a camera. It is roughly spherical in shape. Its outer case is composed of three layers. The outer cover is called sclerotic coat. This coat is white and hard. This hardness is necessary to offer protection to the inner sensitive parts of the eye and to maintain the globular shape of it. Next to this (inside) is the 'choroid coat': It is a thin black lining, meant to keep out light from entering through the wall and to absorb stray light inside the eye. The innermost sensitive layer is called 'retina', It is compared to sensitive film of a camera. Rods and cones are distributed in it. Cones are distributed thickly in the foveal region and they become scanty as they approach the periphery. Rods are scanty and are distributed at periphery. They respond to dim light, whereas cones respond to bright light and broad day light. At the front of the eye we find a transparent structure bulging out known as 'cornea'. Just behind the cornea, lies the 'iris'. It is black or blue or brown coloured disc. Iris has two groups of muscles called 'circular muscles and radial muscles.' These muscles regulate the size of the pupil depending upon the brightness of light. Iris also contains light sensitive pigment spots. At the centre of the Iris, lies the 'pupil.' It is a small opening through which light enters into the eye. The pupil

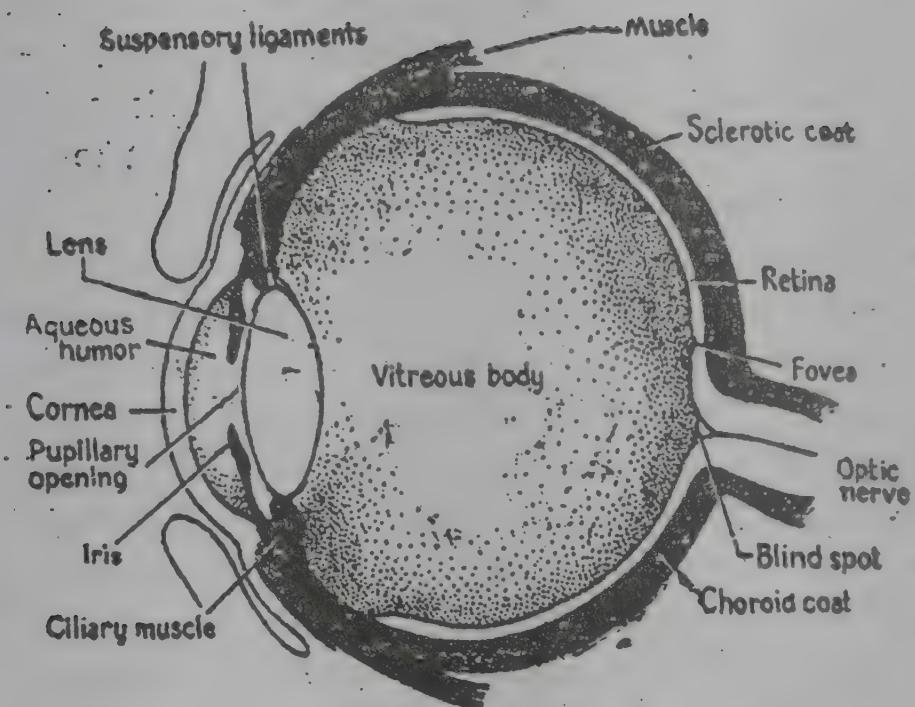


Fig No. 6 Structure of human eye Munn-1966

contracts when the light increases and expands when the light decreases. Behind the pupil, a 'lens' is held on either side by ciliary muscles. This lens is highly elastic and hence its shape can be altered according to the nearness of the object being focussed. Depending upon the distance of the object, the shape of the lens is altered by ciliary muscles. Either it becomes flat or bulges depending upon the distance of the object focussed. In between the cornea and the pupil, there is a certain amount of space which is filled with a kind of liquid called 'aqueous humour'. The large space behind the lens is filled with 'vitreous humour' which maintains the shape of the eye. In fact, both the liquids are transparent and hence the light passes through and reaches the retina. Very close to the blind spot lies the 'fovea' which is the most sensitive part of the retina, wherein cones are thickly distributed. Fovea is slightly yellowish in colour. This is the point of clearest vision. Just left to this lies 'the blind spot area' wherein there are neither rods nor cones and hence it is not sensitive to any visual stimulation. This greyish spot is the area from where the optic nerves carry the neural impulses from the eye to the visual area of cortex. Thus we see a number of parts of the eye of which each is designed to carry on its own activity.

How do we see ? Light is composed of electromagnetic waves which are nothing but radiant energy emanating from the sun. This energy faces various objects which in turn either reflects or absorbs or refracts. When this enters the eye it becomes a visual stimulus. So we only see the light reflected from the objects but not the objects directly. Thus the reflected light from the objects falls on the cornea, enters through the pupil, falls on the lens and thereby acts upon the rods or cones which are distributed in the retina. Thus the stimulation of the receptors, (rods or cones) make the receptors to release the neural impulses. These impulses are carried by afferent neurons to visual cortex. The visual cortex interprets the coded impulses, which will be experienced as the object in reality. The importance of eyes in getting the knowledge of the world and to react to the world around is well known.

## HUMAN EAR

Next in importance to vision is audition. The organ concerned with audition is ear. It plays a significant role in the development of language and communication with physical and social environment. With the help of ears we come to know of what is happening around us and to deal with the stimulus of great distance from us. It plays an important part in space perception and warns us of the approaching danger earlier than eyes. It is a medium of artistic expression and aesthetic enjoyment. If eyes are single directional, ears are omnidirectional in nature. In order to understand how the auditory system operates, brief knowledge of the structure of the ear is necessary.

The human ear is divided into three parts—the 'outer ear', the 'middle ear' and the 'inner ear'. The outer ear consists of the 'pinna'(auricle), which is nothing but external ear flap. Next to it is the 'external auditory meatus or auditory canal.' This is also known as S shaped passage. It is through this the sound waves enter into the ear. At the far end of this passage lies the 'tympanic membrane or ear drum.' This separates the outer and middle ear. The middle ear is a cavity filled with air and contains three ossicles or bones—'Malleus or hammer.'

Incus or anvil and stapes or stirrup. It also contains the 'eustachian tube' which connects the middle ear to the posterior part of the nasal cavity and provides a means of ventilating the middle ear.

The inner ear is made up of cavities and tunnels that are filled with liquid and embedded in the bone. The inner ear consists of 'vestibular organ' and cochlea. The vestibular

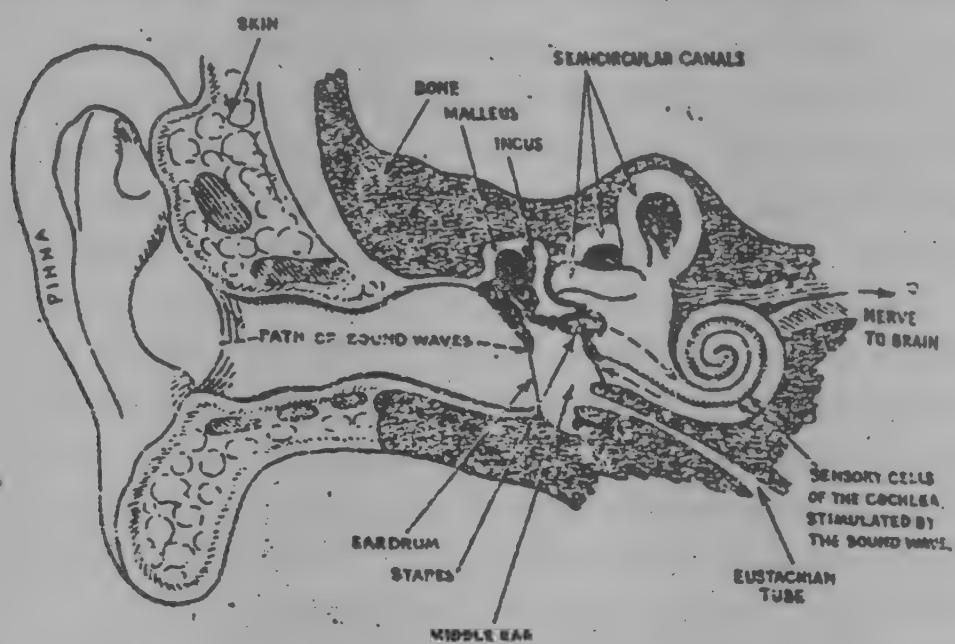


Figure ; 7 Structure of human ear (Frank A Geldard 1962)

organ is nothing but three *semicircular canals* filled with fluid. It is nothing to do with hearing but it is concerned with balancing and orientation of the body. So it is known as *non-auditory labyrinth* or static sense organ. Two membranes viz, 'the round window and the oval window separate the middle ear and the inner ear. The last bone of the middle ear viz, the stapes is attached to the oval window. The round window acts as a surface between air of the middle ear and fluid of the inner ear.

The inner ear also contains another important structure concerned with audition, known as *cochlea*. It is spiral like structure having three canals—(1) *Vestibular canal* or scala vestibuli (2) *Tympanic canal* or scala tympani (3) *Cochlear canal* or scala media. Vestibular canal begins at the oval window and terminates at the apex of the cochlea. The tympanic canal begins at the apex and terminates at the round window.

of the inner ear. Both the vestibular and tympanic canals are connected at the apex of the cochlea by a small opening called *helicotrema*. In between these two canals lies the cochlea canal. Vestibular and tympanic canals are filled with a kind of fluid called *Perilymph* and the cochlear canal is filled with *endolymph*. The vestibular and cochlear canals are separated by a thin membrane called *membrane of reissner*. This has nothing to do with audition but allows the movements of one canal to act upon the other canal. The cochlear and tympanic canals are separated by a thick membrane called *basilar membrane*. This membrane is a very important structure, from the point of view of hearing. *Organ of Corti* is resting on the basilar membrane. The basilar membrane consists of small fibres from one end to the other. Some fibres are longer and loose at the tip of the membrane. Short fibres with greater tension are at the base. Different lengths of fibres are sensitive to different wave lengths. So different pitches cause different parts of this membrane to vibrate. So any damage to any part of this membrane causes deafness for the sounds of that pitch (frequency). On the organ of corti there are about 30,000 *sensory neural endings*. The hair cells which comprise the primary receptors of hearing are at these endings: *The auditory branch of the eighth nerve*, connect the neural mechanisms within the organ of corti, to the brain.

How do we hear? Every object has elasticity. So when it is disturbed it starts vibrating. These vibrations of the object act upon the air around and produce sound waves. They are transmitted by air. Such waves when they reach the ear, the pinna collects them and directs them into the ear through external auditory meatus. These sound waves strike the ear drum at regular intervals and with a particular rate. The vibrations caused by sound waves, in the ear drum, will be transmitted through malleus, incus and stapes in order. The last bone of the middle ear viz: stapes, strikes the oval window with the same rate. These vibrations of the oval window will be transmitted to vestibular canal of the cochlea and thereby to tympanic canal. These vibrations stimulate the fibres on the basilar membrane. In turn they act upon the hair cells

which contain primary receptors of hearing. They discharge the neural impulses corresponding to the number of sound waves and their intensity. The auditory branch of nerves carry these impulses to the auditory area of the temporal lobe, where in these coded impulses will be interpreted or translated into the sensation of hearing. The result is the experience of hearing. The experience of pitch, intensity, timbre, beats, etc., are discussed under sensations.

Deafness may be due to injury to the eardrum, stiffness in the bones of the middle ear, disease or injury of the oval window, injury to cochlea or the auditory nerves and many other causes.

### TONGUE (Gustatory sense organ) :

The gustatory and olfactory sense organs are tongue and nose. They are considered as twin sense organs, because they

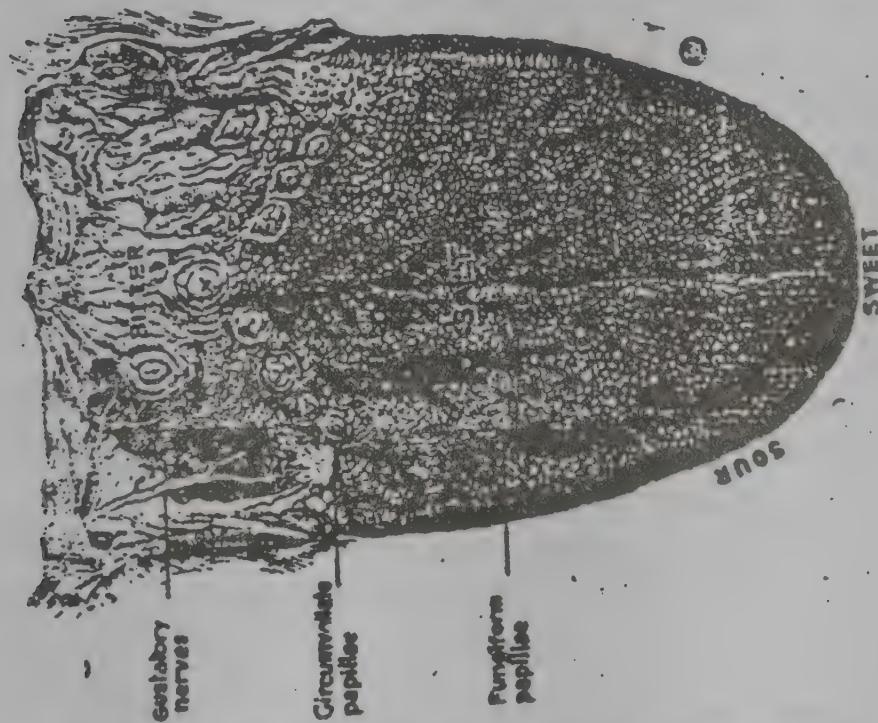


Figure 8 : Structure of the tongue (Munn 1966)

help each other to provide the full knowledge of the object. They are also known as chemical senses and contact senses because, it is only when the object comes in contact with these sense organs the knowledge of the objects becomes clear to the individual. The gustatory organ helps to maintain the health

of the organism: either by rejecting or by accepting the food. If it is not suited to the organism it rejects and accepts if it is suited. Thus it provides the organism the knowledge of the world around by contact.

Tongue which is the gustatory sense organ has a rough surface because of innumerable papillae distributed all over it. These papillae are broadly classified into—(1) Circumvallate papillae, (2) Fungiform papillae. The *circumvallate papillae* are bigger in size but less in number. They are about nine in number, located in V form at the back of the tongue and not at the tip. Each papillae contains several taste buds, i.e. about 200 taste buds. And each taste bud has several taste cells which are the actual taste receptors. These receptors are connected with nerve fibres to carry neural impulses to the gustatory area of the temporal lobe, when impulses are released by taste buds. These taste buds are sensitive to bitter.

The *fungiform papillae* are innumerable but smaller in size. They are distributed throughout the length and breadth of the tongue. As said earlier each papillae contains a number of taste buds served with nerve fibres to carry the neural impulses to the gustatory area. When these impulses are interpreted by the gustatory area of the temporal lobe, the individual experiences taste. The papillae distributed at the tip of the tongue are sensitive to sweet, Those on the sides are sensitive to sour and the entire tongue is sensitive to salt. The various tastes that we experience are the different combinations of these four primary tastes.

**How do we taste ?** In order to have the taste of the food we eat, it must be converted into liquid, i.e., it must be dissolved in the saliva produced in the mouth. This dissolved food stimulates the taste buds which in turn release the neural impulses. These neural impulses will be transmitted to gustatory area through sensory nerves. These impulses will be interpreted to give rise to the experience of taste.

### **Nose (Olfactory Sense organ) :**

Olfactory sense organ is not so important to man as it is to lower animals. However in the absence of vision and

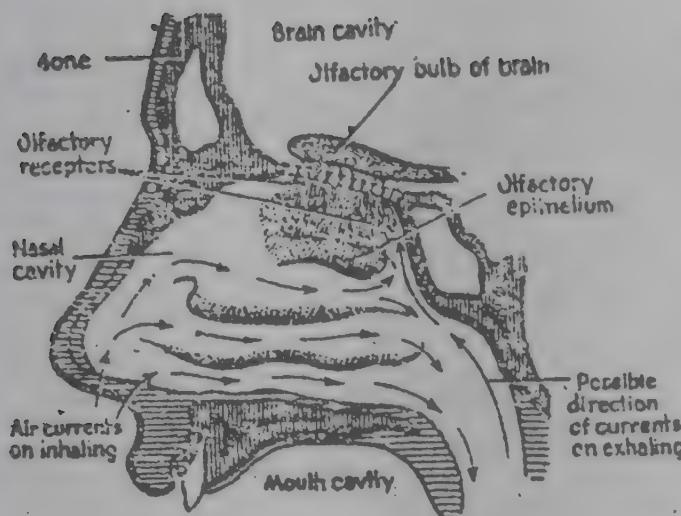


Fig 9. Structure of olfactory Organ  
(Mun 1966)

puts us on guard when the food stuff is unfit to eat. It also enables the infants or babies to select the suitable food stuffs. The stimulus must be in gaseous form to stimulate the receptors of this sense organ.

The organ concerned with olfaction is nose. The nasal cavity is divided into four compartments by three bone ridges. The upper compartment has a number of *olfactory epithelium* and olfactory receptors. They are connected with olfactory bulb of the brain. The nerve fibres run from the upper end of the olfactory bulb, to olfactory area of the temporal lobe.

**How do we smell?** To smell an object the stimulus must be in gaseous form. When we inhale air, it carries the odour of the object and when it reaches the upper chamber of the nose it stimulates the olfactory epithelium and receptors. The neural impulses released will be transmitted to olfactory bulb through receptors. Thereby the neural impulses will be transmitted to olfactory area of temporal lobe, through olfactory nerves. These impulses will be interpreted there and the individual experiences smell of the object.

#### NON-AUDITORY LABYRINTH-Static Sense Organ :

The knowledge of the position and the movements of the body are due to the special structure located in the inner ear

audition the sense of smell plays a very significant role in the adjustment of the individual to his environment. This being a distance receptor organ, informs us of the presence of the object before we come in contact with it. It

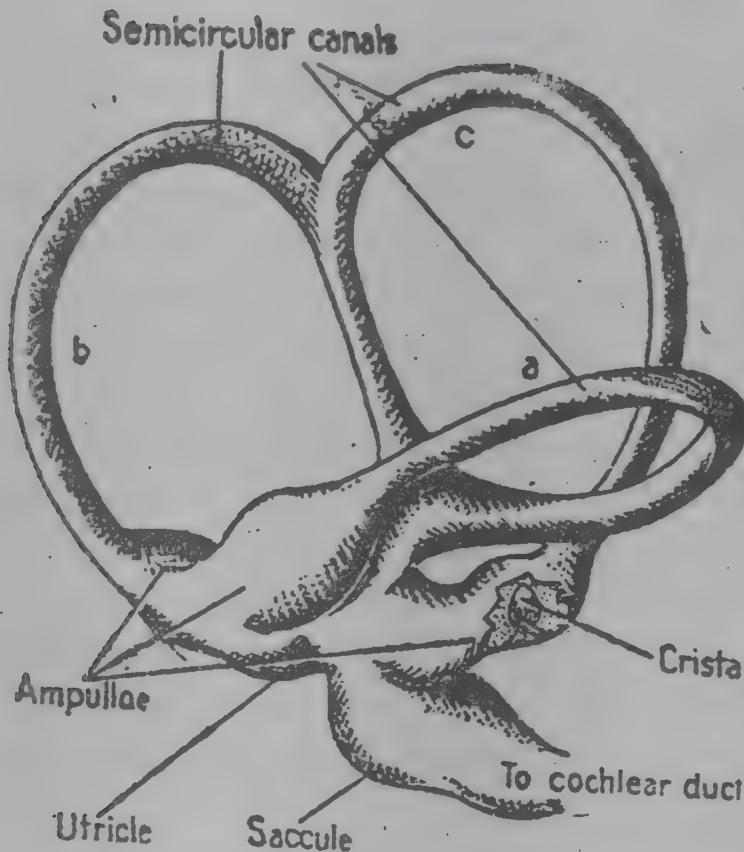


Figure 10 : Static sense organ  
(Munn 1966)

viz., non-auditory labyrinth or vestibular organ. This organ has *three semicircular canals* and two small sac like chambers called *utricule* and *saccule*. These two are jointly called *vestibule*.

These three semicircular canals are filled with a fluid known as *Endolymph*. The same fluid is found in the vestibule also. The three

canals are set in three planes: One is horizontal and the other two are vertical and at right angles to each other. This affords three dimensional system. Thus every possible movement of the head has a corresponding effect on the liquid in the canals. At the base of each semicircular canal there is a swollen portion called *ampullae*. Each ampullae contains a structure known as *crista*. Crista contains some specialized nerve endings which are hair like in nature. When the head moves either to the right or to left, up or down, the fluid either in one or all the three canals flows towards the corresponding directions and this disturbs crista. Bending of these hair like projections stimulate the associative nerve fibres. These nerve fibres carry the released impulses to the brain. Translation of these neural impulses give rise to the experience of movement, direction and position of the head and body. Rapid rotation and certain other types of movements affect the semicircular canals and the vestibule. This temporarily disturbs the sense of balance and produces giddiness. The deaf-mute who has congenital defective inner ear, does not experience motion sickness. He will have no clue

about the position of the body when eyes are closed.

**Kinaesthetic Sense:** This is also known as muscle sense. With the help of this sense organ one can understand the position and movements of his limbs. With the help of this any normal individual can touch any part of his body with his eyes closed, can move his limbs in any direction and can hold it in any position. Further one can understand the relative weight of any two objects. Nevertheless one can walk in the street without paying attention to what his legs are doing. A typist without looking at the keyboard types and a person goes to switch board to switch on the light even in the darkness. All these automatic, stereotyped, muscular activities are due to kinaesthetic sense.

The structures which are concerned with these automatic stereotyped, habitual activities are kinaesthetic receptors, such as *muscle spindles*, *golgi's tendons* and *pecinian corpuscles*. These receptor organs are located in the muscles, tendons and joints. When the parts of the body move, these receptors are stimulated by stretching and pressure, giving rise to kines-thesis. This sense plays a major role in maintaining the erect postures, walking, talking, typing, dancing, swimming and other motor skills. If the individual is affected with the disease called locomotor atoxia, the muscle sense in him will be lost completely.

### **SKIN SENSES (Cutaneous sensitivity)**

Cutaneous sensitivity involves only four senses viz, touch pain, warmth, and cold. But now this notion is under attack. There are some evidences to show that each of these senses can be broken down into atleast two senses. A day may come to say, that there are 15 to 20 different senses.

The inner layer of the skin called the dermis contains four kinds of sense receptors viz. (1) Free nerve endings, (2) Meissner corpuscles, (3) Krause end bulbs. (4) Ruffini Cylinders. In addition to these four kinds of receptors we also see pacinian corpuscles.

(1) *Free nerve endings* mediate pain. They are found almost in every part of the body and so pain is perceived in almost all parts of the body. The fibres of free nerve endings

are thicker and carry impulses at a greater velocity. Every part of the skin is covered with network of microscopic blood vessels. The free nerve endings terminate in the smooth muscles and are surrounded by blood vessels. If these free nerve endings are stimulated by a pin or pinch, they discharge

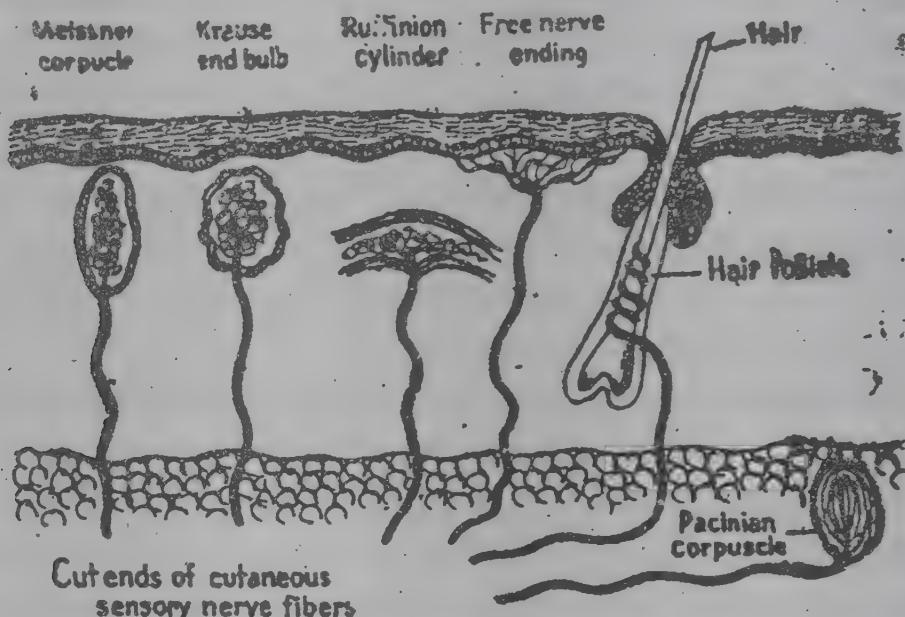


figure 11 skin senses (Munn 1966)

the neural impulses which are transmitted to the concerned part of the brain, wherein they are interpreted. This gives rise to the experience of pain. These pain receptors vary in number from 100 to 175 per square centimetre. They are very scanty in the mucus lining of cheeks and lips. And hence pain is absolutely less in these areas.

(2) *Pressure spots* are also known as touch spots. Meissner corpuscles mediate light touch, whereas pacinian corpuscles mediate deep pressure. These spots or receptors vary in density from one area to the other area of the body. On the average they are about 25 per square centimetre. They are more in the hairy region and less in the hairless region. When they are stimulated the impulses discharged will reach somaesthetic area of the parietal lobe. Interpretation of these impulses give rise to the experience of touch.

(3) *Krause end bulbs* mediate cold and they vary in density from area to area. On the average there are about 7 to 13 per square centimeter. The temperature range for cold stimulation varies from  $10^{\circ}$  C to  $30^{\circ}$  C. Paradoxical cold sensation is

experienced frequently at 45°C to 50°C. These receptors also discharge the impulses when stimulated. It is communicated to and interpreted by somaesthetic area which gives rise to the experience of cold.

(4) *Ruffini cylinders* mediate warmth. They are less in number compared to cold spots. The temperature range for warmth varies from 35°C to 70°C with varying physiological zero. A paradoxical warmth is stimulated at 25°C to 31°C but this is less than paradoxical cold sensation in number.

Thus the different sense organs discussed so far provide the knowledge of the world in their own ways and help the individual or the organism to adjust to the social and physical world around. Each sense organ contributes its mite to various psychological functions, such as learning, memory, thinking, reasoning, emotions, intelligence, perception, attention etc.

### 3. GLANDS

Another biological basis of behaviour is glands. Glands are considered as small chemical factories located at various parts of the body. They determine the behaviour of the individual to such an extent, as to make him normal, abnormal, or supernormal in his behaviour. They exert profound effect on intelligence and temperament as well as on physical health and growth. So the knowledge of the glandular system is very essential to understand the behavioural development of the individual.

These glands are located in different parts of the body. Each gland is nothing but a group of cells. Some of them secrete some chemical products and pour them directly into the bloodstream. They do so because they have no ducts or pipes of their own to pour their secretion into the blood stream. Such glands are known as 'ductless glands or endocrine glands and the chemical products secreted by them are known as *hormones*. Certain other glands also secrete certain chemical products, but they have ducts of their own to transmit their products either into blood stream or to the concerned part of the body. Such glands are known as *duct glands* or *exocrine glands*. Both these glands

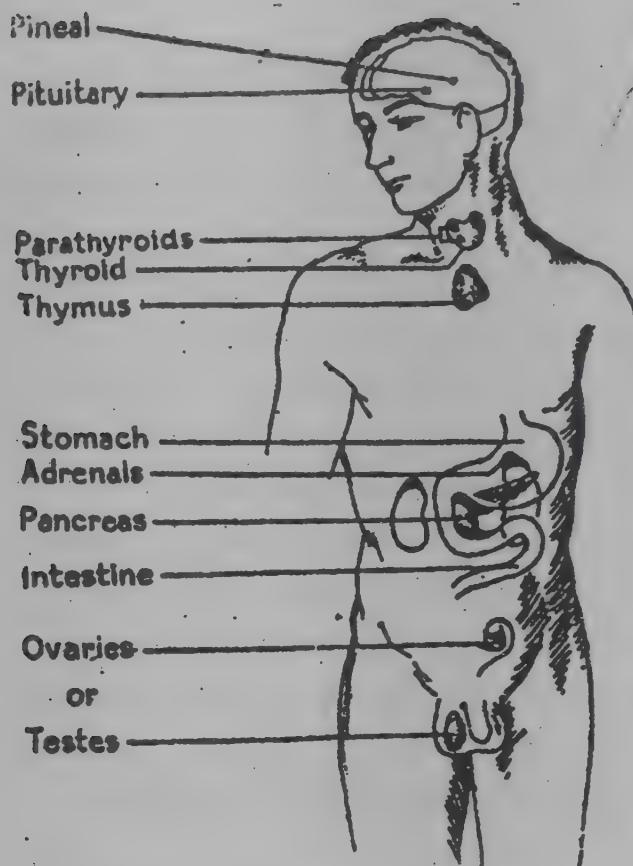


Figure 12. Endocrine glands  
 (James O. Whittekar) 1970.  
 glands and (4) a part of pancreas.  
 are considered as duct as well as ductless glands.

Apart from secretory duct and ductless glands, there are certain excretory duct glands or *exocrine glands*. These glands abstract certain waste materials from the blood stream and eliminate them from out of the body through the concerned channel. Some of the excretory duct glands are—(1) sweat glands (2) subceous or oil glands (3) tear glands and some glands in the kidneys and other excretory organs. Though these glands play significant role in maintaining the health of the individual, they are not so significant from the point of view of behaviour, whereas ductless glands play a very significant role in determining the behaviour of the individual. Hence a brief account of them is mentioned in this chapter.

### (1) Thyroid Glands

Thyroid glands are situated at the base of the neck on either side of the wind pipe. They are two in number both in man and in other mammals. They secrete two hormones known

abstract certain raw materials from the blood and manufacture their own products and pour them back into the blood stream. Some important ductless glands (endocrine glands) are—(1) Thyroidglands, (2) Parathyroid glands, (3) Adrenalglands, (4) Gonads, (5) Pancreas, (6) Thymus glands, (7) Pituitary glands etc. Some of the secretory duct gland are—(1) salivary glands

(2) mammary glands, (3) a part of the sex The latter two glands

as *triiodothyronenei* and *thyroxin*. These hormones are very essential for oxidation in the body, metabolic activity and energy output. They are also partly responsible for the growth of the individual from prenatal stage to maturity.

During infancy or childhood, if there is under-secretion of thyroxin either due to injury or disease of the glands the child develops *cretinism*. Under-secretion is technically known as *hypothyroidism*. *Cretinism* which is the resultant of hypothyroidism is characterised by retarded skeletal growth, poor body proportions, soft bones, low basal metabolic rate, arrested sexual development, imbecility and dwarfism. His facial features are bloated, broad nose, dry and wrinkled skin, thickened tongue, scanty and brittle hair, sluggish mental activity and apathetic look. In short very coarse appearance. The *cretin* is often a deaf-mute. His mental deficiency depends upon the age at which the deficiency started and the amount of glandular hypo-function.

If the glands become under-active in later life, it leads to condition known as *Myxoedema*. It is characterised by low basal metabolic rate, thick and puffy skin, dry brittle and sparse hair, apathetic and sluggish mental activity, increased body fat and weight, decreased heart beats, extremely sensitive to cold and infections, but earlier level of intelligence will be retained.

On the other hand, over secretion due to pathologically enlarged glands is known as *hyperthyroidism*. This condition is known as *expothalamic goitre* or *Grave's disease*. It is characterised by swelling at the base of the neck, increased heart-beat and body metabolism, reduction in weight, high blood pressure, precocious sexual development, etc. Psychologically the patient becomes overactive, tense, nervous, unstable, and insensitive to cold. He shows tremors, loss of weight, emotional excitability and some psychotic symptoms like delusions and hallucination. (J. C. Coleman 1975). He also suffers from insomnia. Lack of iodine in diet results in less dangerous form of goitre. Where water is deficient of iodine results in goitre. Hypothyroidism can be treated, by administering thyroid extract. If treated early, the condition improves

beyond recognition.

## 2. Parathyroid Glands

These pea sized bodies are four in number. They are embeded in thyroid glands, but are independent in function. They secrete parathormone hormone, which is concerned with calcium metabolism of the body. Hence this hormone is necessary for the cartilage-models to become bones and the bones to grow. Both under-secretion and over-secretion affects skeletal bones and teeth. Removal or destruction of these glands cause *Tetany*—muscular twitching, tremors, cramps and convulsions (J. C. Coleman). These inturn affect the behaviour.

## 3. Adrenal Glands

Adrenal glands are two in number and they are located at the top of the kidneys, but they are functionally unrelated to kidneys. Adernal glands are divided into two parts : (1) adrenal medulla. (2) adrenal cortex :

Adrenal medulla : Secretes *adrenaline*, and pours it into the blood stream directly. This part of the gland is closely related to sympathetic nervous system which controls the physical reactions induced by emotion. So this hormone causes increased blood pressure, heartbeat and rate of breathing, postpones fatigue, wide opening of air passage of lungs, suspends the activity of the stomach and intestine, releases glycogen from liver etc. All these changes are only to help fight or flight from the emergency situation. These changes are found under emotion. Psychologically the individual will be *tense* or on *edge* and experiences confusion. This condition adversely affects learning, memory, thinking and reasoning. Some studies have suggested that *Schizophrenia* may be caused by abnormal functioning of the adrenal glands.

Adrenal cortex : Secretes a number of hormones—*aldo-sterone*, *cortisol*, *corticosteron*, *cortisone*, *17-ketosteroids* etc. These hormones play important roles in body metabolism and these hormones are secreted more under stress. Destruction of adrenal cortex leads to *Addison's disease*. This disease is caused by deficiency of *deoxycortone* and characterised by anemia, increased fatigability, loss of appetite, listlessness,

irritability and brownish coloration of the skin, (James coleman 1975). As certain compounds of 17-ketosteroids are similar to sex hormones. Hyperactivity of adrenal cortex leads to precocious development of sex organs and secondary sex characteristics. If a woman is subjected to it she develops masculine appearance like beard, moustache, hairs on the chest and limbs, masculine voice and manish disposition. Cortisol is useful to suppress inflammatory condition and minor aches and pains. Cortisone is used to relieve rheumetoid arthritis, and to save premature infants from critical illness. Some investigators are of the opinion that administration of certain cortical hormones has some beneficial effect on schizophrenic patients (Zubek & solberg 1954).

#### 4: Gonads :

Gonads are also known as sex gland. The ovaries in the female and testes in the male are the sex glands. The ovaries produce and release ova whereas testes produce and release sperms. Both the glands produce estrogen and androgen hormones in addition to the production of ova in woman and sperm in man. In woman estrogen is produced more than androgen but androgen is produced more than estrogen in man. Because of this disproportion in the secretion of these two hormones man behaves like man and woman behaves like woman. This proportion remains high throughout the reproductive years. Cessation of these hormones cause *menopause* in woman and *climacteric* in man. Consequently reproduction comes to an end. These glands are controlled and regulated by gonadotropic hormone of the pituitary gland. Shortly before puberty the increased output of gonadotropic hormone stimulates rapid growth and development of primary and secondary sex characteristics in both boys and girls. The girls around 13 years and the boys about an year or two later attain puberty. The usual indication of attainment of puberty is menarche (The first menstrual flow) in girls and nocturnal emission in boys. These menstruation and nocturnal emmissions cause anxiety in grils and boys, if they have not received sex education earlier. Following the sexual maturation the genital organ and the secondary sex characteristics further undergo develop-

mental changes. In addition to these changes the hyperactivity of the sweat and oil glands on the face, armpits and around genitals, secrete a lot of sweat and oily substance and cause mental anguish. In order to cover up the pimples and blackheads girls take to beauty aids and if they fail to cover up, they develop anxiety.

During childhood both boys and girls will have little difference in height, weight, body proportions, skin texture, muscular strength, voice, hair distribution etc. With the attainment of the sexual maturity and the secretion of the sex hormones, secondary sex characteristics appear at puberty in both boys and girls. Girls develop some striking features such as broadening of hips, development of breasts, pubic hair (around the genitals) and auxiliary hair in the armpits, change of voice, gradual coarsening of the skin and shyness. Following these changes girls show interest in the opposite sex. On the other hand boys show some structural changes in the bones and skeletal proportions. Their shoulders become relatively broader than the hips, and there is growth of pubic hair, auxiliary hair, hair on the chest, beard and moustache on the face, change of voice and interest in the opposite sex. Following these changes the adolescent boys and girls show boy crazy and girl crazy love and finally romantic love, which culminates in marriage.

Under secretion or the absence of secretion due to castration, (Eunuchism) makes the animals and children to remain sexually immatured. In the sense the primary sex organ do not develop and the secondary sex characteristics do not emerge in both male and female. If these glands are operated in animals after maturation the sex urge diminishes gradually and finally disappear, whereas in the case of man the urge may decrease but does not disappear. Sexual activity is more controlled by habit and social factors than biological factors in man, and it is the opposite in animal (Whitteker 1970). The lowered out put of hormone in the middle age, results in mild or moderate mental depression, lack of energy, nervousness, tiresomeness, and hot flushes in woman. In man it is associated with, lack of energy, moderate mental depression, and

reduced sexual activity. (J. C. Colemen 1975). These symptoms can be alleviated by estrogen therapy to woman and testosterone therapy to man.

variation in the hormonal output in addition to sociocultural inhibitions or stimulation, may result in sexual deviations, such as impotency in man or frigidity in woman. Beastiality, masturbation, homosexuality trans-sexuality and other forms of deviations may also appear. According to Freud, mental disorders are due to repressed infantile sexuality. Thus sex glands through their hormones determine and direct the normal as well as abnormal behaviour to a very great extent (Zubek and solberg 1954.)

### 5) Pituitary Gland :

The pituitary or hypophysis is a small oval shaped, pea-sized body, located at the base of the brain in the cranial region. As it is the most powerful gland which determines and directs the functions of all the other glands it is known as the *master gland or the master of endocrine orchestra*. Its secretion to a large extent is controlled by the hypothalamus with which it is connected by a stalk. It is made up of two lobes viz, the posterior and anterior.

The *posterior lobe* secretes two hormones which are concerned with regulation of water balance of the body and the stimulation of the activities of certain smooth muscles of the body. These two hormones are very important from the stand point of the behaviour mechanism.

The *anterior lobe* secretes a good number of hormones which are grouped into- (1) those which affect skeletal growth, fat, protein and carbohydrate metabolism and secretion of milk. (2) The tropic hormones which control the functions of all the other glands. For example : Thyrotropic hormone controls thyroid glands, adrenocorticotropic hormone (ACTH) controls adrenal cortex, gonadotropic hormone affects the functioning of the sex glands, prolactin stimulates lactation, progesteron stimulates maternal urge and pancreatropic hormone controls pancreas. If pituitary gland is operated or injured many of these glands undergo degenerative changes and their output will be reduced.

*Phyone* a hormone of the anterior pituitary if secreted

more during growth period the individual becomes a *giant of 7 to 9 feet tall*. This is known as *Gigantism*. Over-secretion after the cessation of growth leads to a condition known as *acromegaly*. The individual will have enlarged joints and extremities markedly thick and coarse features. Whereas under-secretion during growth period causes *dwarfism*. He is technically known as *midget*. He will have sharp and attractive features with short stature, but his intelligence is normal (J.C. Colemen 1975). The effect of under secretion or over-secretion depends upon the temperature in the environment in which the individual is brought up. Tumor or infection of the anterior pituitary may result in *simon's disease*—a condition somewhat similar to *myxoedema*. (Rex Knight and Margaret knight 1964.) The body metabolism will be lowered and there will be loss of sexual function. In some cases there will be emaciation and premature senility, whereas slight over activity of the anterior pituitary is not a disadvantage. The person may have above average height with strongly marked features. He will be usually forceful, energetic and clear headed. Many of the world famous men have been of this type. (Rex Knight and Margaret Knight 1964).

#### **(6) Pineal Gland :**

It is a small oval shaped structure located deep within the cerebral hemisphere. From recent studies on animals it is proved that it is related to mental, skeletal and sexual development. It is found to exert a stimulating effect on the sex organs of the aged females (ovaries and uterus).

#### **(7) Thymus Gland :**

It is located in the region where the throat joins the chest. This large gland at childhood starts shrinking around puberty and reduces to the minimum during adulthood. It is found to stimulate the vertical growth and development of the individual and withholds premature sexual development. Administration of thymocrecin to matured females has revealed few copulatory and antagonistic responses and more indifferent responses to the approach of the male.

#### (8) Pancreas :

Pancreas is located near the stomach in between the adrenal glands. It secretes pancreatic juice which helps digestion of food. Islets of Langerhans located in pancreas secrete insulin, which is concerned with the regulation of the blood sugar. An increase or decrease of insulin in the blood causes low body temperature and coma. High level of blood sugar (diabetes) causes chronic nervousness, irritability, anxiety and depression. Reduction in blood sugar also causes violent convulsive seizures which may last for several minutes and recur at frequent intervals. (J.C. Colemen 1975).

In conclusion it may be said that glands play vital role in the behaviour of man and animal. The physical and mental growth, development and efficiency depend upon the normal or optimum functioning of these glands. Though abnormal variations in their functions are rare, the effects of such variations will have marked effect on the normal or abnormal behaviour. Hence the knowledge of functioning of these glands is very essential to understand, to direct and to predict the behaviour of man and animals.

## CHAPTER III

# Heredity And Environment

### INTRODUCTION :

There is a popular notion that life begins at birth. But biologically life begins at the moment of fertilization (conception), i.e., when a matured sperm of a man fuses with matured ovum of woman. It is the most crucial event in the life of an individual because the biological substances present in the sperm and ovum determine the sex, biological, physiological and psychological characteristics of the emerging individual. Thus the 'biological heredity' by interaction with the prenatal and postnatal environments determine the potentialities of the individual. The knowledge of such hereditary factors and their functions help us to understand the growth, development, similarities and differences in physical, physiological and psychological make up of an individual. Similarly the knowledge of the 'environment' which shapes the growth and developmental pattern of heredity potentials, is necessary to understand the individual. The individual is a psycho-biological organism emerged out of the interaction of heredity and environment. Each individual is an integrated unit, different from others. He is said to be purposive, striving, selective adjusting and animated organism. The 'development' of the individual refers to emerging structures and potentialities from a single fertilized egg or ovum, to expanding behaviour and declining abilities in the old age. Now let us try to understand what is heredity ? What is environment ? How do they interact and determine the growth and development of an individual ?

### HEREDITY :

Each individual is born out of a single 'fertilized egg' of a woman. This egg or cell is smaller than a pin head. This ferti-

lized egg or ovum has a 'nucleus' surrounded by 'cytoplasm' which is a mass of relatively undifferentiated protoplasmic material. The 'nucleus' is a differentiated material which has chromosomes or coloured bodies. These are involved in genetic transmission. The chromosomes are always in pairs. They differ in size, shape, number and genes arrangement from species to species but are alike in all members of a species. In human females there are 23 pairs of chromosomes, whereas males have 22 pairs + 2 singles of which one is X and another is Y chromosomes. This Y is peculiar to only males. It is this last pair which determines the sex of the individual. The female egg contains only XX-chromosomes as its last pair, So her contribution to sex determination is the same whether the baby is male or female.

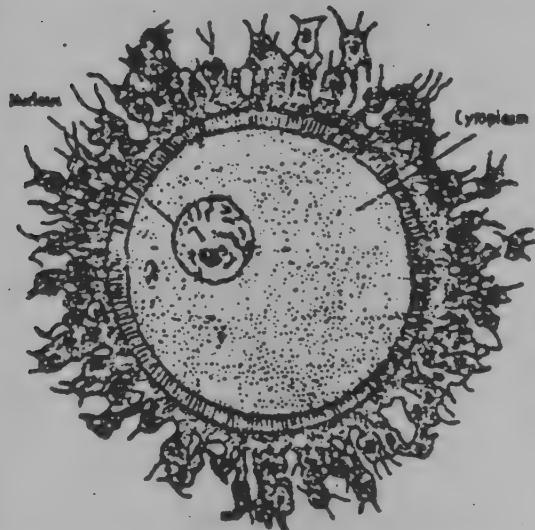


Figure 13 : A Human ovum, It contains the nucleus, cytoplasm and surrounding membrane, Cells shown outside belong to mother and not to the ovum, (After Munn p. 90)

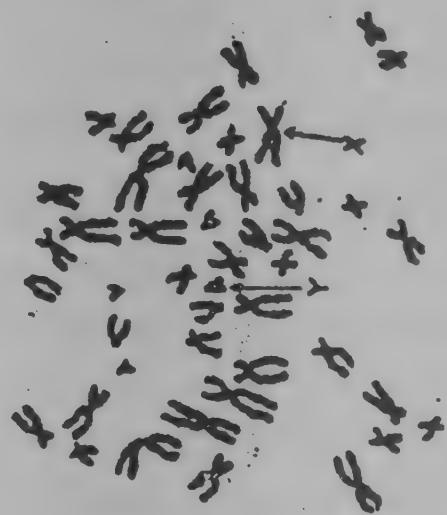


Figure 14 : The human chromosomes, There are 46 chromosomes in all. Also shows an X and a Y chromosome. (After Munn p. 90).

Each chromosome consists of a string of beads like particles called 'genes'. Genes are the true carriers of hereditary traits. So they determine various physical and psychological traits of an individual. For example : colour of the skin and eyes, the height, skin texture, intelligence, tempera-

ment etc. Different regions of the chromosomes determine different characteristics.

The chemical make up of genes is now under intensive investigation. The most important constituent is Deoxyribonucleic acid or DNA. This DNA is found in all chromosomes and some of the properties are found in genes. The structure of DNA is believed to have genetic information in coded form. At appropriate times in the development of the cells, this information is communicated to determine the course of further development. This action of the genes on cytoplasm changes the shape and other characteristics of the cell. Genes and the Internal environment change the cells from their original shape to form muscles, bones, nerves etc. These parts constitute the response mechanisms. Each gene combines with other genes to produce a variety of characteristics and thus determine the hereditary traits of the organism.

## Dominance-Recessiveness:

Normally any individual is heterozygous for many characteristics. For example: an individual who inherits a gene for brown eye from father and a gene for blue eye from mother, what will be the colour of the eye, of the neonate? This can be explained by the concept- "Dominance and Recessiveness. Of the two genes inherited by the child from father and mother, one of the genes inherited exerts greater influence than the other gene. The gene which exerts greater influence is called "dominant gene" and the other gene which does not exert influence but remains within is called "recessive". In the case of eye colour, the gene for brown colour is always dominant over the gene for blue colour. Now if a gene for brown colour is transmitted by father and a gene for blue colour is transmitted by mother to the neonate, the brown colour gene being dominating, the neonate will have brown colour eyes. The gene for blue colour being submissive, becomes recessive and does not express in the colour of the eyes of the neonate. Though the

recessive gene does not express itself, it does not disappear, rather it will be transmitted to next generation. The same principle holds good regarding the other characteristics of the neonate.

Geneticists named the dominant gene with the capital letter "B", and the recessive gene with small letter "b". Now if the neonate receives from each parent dominant genes "BB", it is called *homozygous*. On the other hand if the neonate inherits one dominant gene from one parent (B), and a recessive gene from another parent(b), it becomes *heterozygous* (Bb). Further if it inherits recessive genes from both the parents it becomes *homozygous* (bb). Now, as the gene for the brown suppresses the gene for blue, both BB and Bb neonates will have brown eyes and only the homozygous "bb" will be blue-eyed. In short out of 4 children of the same *heterozygous* parents, 3 children will have brown eyes and one becomes blue eyes. Same law holds good regarding other traits also.

## Meiosis :

Meiosis is reduction process which takes place to reduce the number of chromosomes from 46 to 23 and to maintain the constancy of the number in each successive generation. It takes place in the reproductive organs, viz., testes of males and ovaries of females. This reduction process is known as germ cell maturation or meiosis. It is only after this process, ripened ovum is expelled from the ovary to facilitate fertilization. The expelling of a ripened ovum from the ovary around 15th day, i.e., from the day of menstruation is known as 'ovulation'. The fusion of the male and the female cells and their nuclei constitutes 'fertilization or conception'. The organism which is the resultant of this fertilization is known as zygote.

## Mitosis :

As understood already meiosis is a reduction process of chromosomes before fertilization. Whereas 'mitosis' is cell

multiplication process or duplication process which takes place after fertilization. Though the cells multiply, the number of chromosomes in each cell remain the same. This multiplication process takes place in geometrical ratio. Following this multiplication process, cell differentiation and formation of 3 different layer-viz., endoderm (inner most layer), mesoderm (middle layer) and ectoderm (outer-layer) are formed. From these three different layers different structures of the organism viz., bones, muscles, nerves and other internal and external organs emerge. Thus the individual who emerges from single fertilized egg becomes a full-fledged human being by the time of birth.

### **Mutation :**

“Inherited bodily changes brought about by alterations of chromosomes and genes” is known as “mutation”. Unlike body cells, germ cells are relatively immune to environmental changes. Only rarely “Spontaneous” alterations or changes in the germ cell structure take place. This brings about sudden appearance of new characteristic in the newly born organism. These changes when they occur, will be inherited to its offspring. Such mutations take place roughly ‘1’ out of every 5000 to 10,000 fruit flies bread in the laboratory - such as, absence of wings, or eyes, extra wing, change of colour etc., other striking examples of mutants are-black sheep, albinorats and guinea pigs. If these mutants are bread true, their offsprings continue to be like them. Some abnormalities in human beings caused by mutation are six fingers in each hand six toes in each foot, twisted hair, peculiar skin colour or shape of the head etc.

Both chromosomes and genes may mutate. This mutation occurs during the process of meiosis and mitosis. During this process chromosomes divide, regroup, split and go through various other manoeuvres. Sometimes paired chromosomes fail to separate and may go to one of the two divided cell, or some time

chromosomes breaks and only a part of it goes to the "correct cell, or either a chromosome or a gene fails to make an accurate "carbon copy" of itself. Such accidents do happen at the early stages "behind the germline. These changed characteristics are transmitted to future generation Chromosome mutations cannot account for all hereditary changes. So we have to look to genes for explanation. Gene mutation involve chemical changes within the gene itself. If we consider the gene-enzyme-cells-behaviour chain we can understand mutation. Gene mutation changes the chemical structure of the gene. This will be reflected in enzymes, metabolism and finally in behaviour.

Morgan found that (1) X-ray bombardment speeds up mutation frequency about 150 times. This is the same as spontaneous mutation (2) Increased temperature and chemicals also increase mutation rate. (3) Smoking (frequent), alcohol also cause mutation.

### **Identical twins, Fraternal twins and Siblings :**

After the first mitotic division of a fertilized egg, the two cells may remain separate and develop independently giving rise to twins. The twins developed out of single zygote are known as 'mono-zygous or identical twins,. As they share the same chromosomes, the sex of both the twins will be the same. So they closely resemble each other in physical and mental characteristics. As they share the same heredity, any differences which appear at later age may be due to environmental factors.

Sometimes two ova are released by the ovary. If both are fertilized simultaneously by two sperms, two individuals emerge, develop and grow to be twins. Such twins born out of two separate ova simultaneously but together are known as 'fraternal twins or hetero-zygous'. Though they are born simultaneously they are not similar to each other because they carry different hereditary traits. As they share different hereditary traits, they may be of different sex or the same sex but will have different characteristics.

There will be greater differences than similarities between the two. Hence they are like siblings but only born together.

'Siblings' are brothers and sisters born to the same parents but with a gap of months or years. Though they are born to the same parents each is different from the other in sex as well as in many other characteristics, because their hereditary endowments are different from each other.

### **Siamese Twin :**

Siamese twins are identical twins, in the sense they are formed out of fusion of a single sperm and an ovum. They are joined at birth, and most commonly at the hip, chest, or head. They are of the same sex and same genetic make-up. This is a rare kind of birth defect. As it is very difficult to deliver, cesarean delivery is inevitable. The first such twins to receive wide publicity were born in Siam (Now Thailand). Siamese twins can usually be separated surgically if they have shared superficial tissues. If they have single heart or single head or some vital organ, surgical separation and survival is also very rare.

### **Prenatal period :**

The duration of time between conception to birth, is known as 'Prenatal period'. The duration of which is 10 lunar months or 9 calender months. This period is divided into, (1) period of ovum. (2) embryonic period (3) foetal period. The 'first period' lasts for 15 days, i.e., from the time of conception to the end of the 2nd week. The second period lasts for about 6 weeks i.e., from the end of the 2nd week to the end of 2nd month. The 'third period' begins from the end of 2nd month and ends at birth. The period after birth is known as 'postnatal period'. From the point of view of growth and development of the individual the prenatal period is very important and crucial. It is during this period innumerable developments and astounding growth take place. At no period in

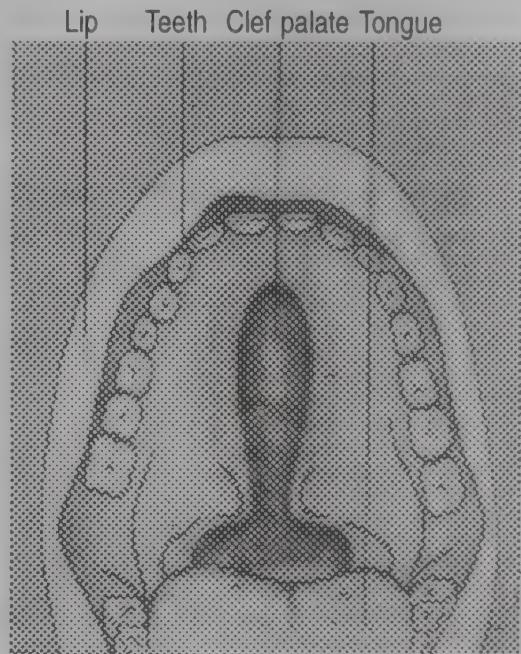
the life span of an individual the growth is so fast and changes are so rapid. This period is considered to be crucial because any damage, injury or deficiency will have a serious impact on the growing individual. This will be discussed under environment.

## Chromosomal Abnormalities :

As discussed under meiosis and mitosis, sometime due to some reasons chromosomal or gene mutation takes place. One such abnormality is "CLEFT PALATE". It is an abnormal fissure in the palate of the mouth, that is present at birth. It is caused by faulty development of the facial structure of the foetus. Very often a cleft palate is accompanied by a similar division in the upper lip, called "harelip". In the normal development, separate tissues fuse together to form the palate i.e., upper lip and upper jaw. Cleft palate occurs, because the roof of the mouth does not develop completely and there will be a vertical gap (fissure) in the roof of the mouth.

"HARELIP" is a congenital cleft in front of the upper lip (a cut in the upper lip.) The cleft may vary in size from notch to a fissure. The fissure (cut gap) extends across the whole lip. Usually it extends from the mouth up into the nostril and it can be on one side or on both sides of the midline. It is normally associated with cleft palate. This can be corrected by surgery.(plastic surgery).

Cleft palate and harelip interfere with the natural sucking ability of the neonate. It must be fed either with a bulb syringe or spoon



Cleft palate occurs because the roof of the mouth does not develop completely

or with a long nipple baby bottle. Plastic surgery is necessary to repair the cleft palate. If it is not corrected by surgery at early childhood, it may cause speech difficulty. Speech therapy is also necessary to correct his speech.

### **Lobster Claw :**

Lobster hand is a rare congenital deformity of the hand. Here the middle digit is missing. The hand is cleft, where the metacarpal of the finger should be. The split gives the hands the appearance of Lobster claws.

Lobster claw is an inherited condition. It often occurs in both the hands and feet. It can skip a generation. It occurs both in males and females equally. The chance is 1 in 90000 babies.

It can be treated surgically to improve function and appearance. Genetic counselling is given to parents who have genetic load

It is called by different names - Lobster claw hand, Lobster hand, split hand deformity, cleft hand, etc.

### **Polydactyly or Syndactyly :**

It is webbing between the fingers and toes. In most cases the condition is inherited. It usually affects both hands and feet. Syndactyly of the toes does not require treatment, but fingers can be corrected by surgery.

Polydactyly is nothing but having one or more extra fingers and or toes. It is probably a most common abnormality of development found at birth. It occurs in about 2 per 1000 children.

The most common form of polydactyly is a small and soft extra finger which contains no bone. It can be removed surgically and normal appearance can be restored. If it is complex polydactyly it will not be repaired until the child is one year old.

### **Haemophilia :**

It is a congenital disorder, where the blood clotting is very slow. Due to this condition any wound or injury even if it is a minor one,

gives rise to prolonged bleeding. This individual will have a risk of anaemia and dangerous loss in blood volume. In addition, pools of blood (Haemotomas) in the tissues or joints may produce varying degrees of disability. Haemophilia is due to deficiency in one of the factors in blood plasma which helps blood clotting normally. Haemophilia occurs almost exclusively in males (Sex linked trait). It is due to genetic defect, transmitted only by women.

Haemophilia is a blood disorder, carried by a gene on the 'X' chromosome. Boys inherit this condition only from their mothers. This X chromosome in their XY pair is always received from the mother. The gene for haemophilia is "Recessive" i.e., the symptoms of haemophilia do not develop if the abnormal X chromosome is paired with a normal X chromosome in the cells of the body. A woman who carries the gene for haemophilia on one of her X pair does not develop haemophilia herself.

### Down's Syndrome :

Down's Syndrome is also known as mangolism. It is also known as "Trisomy 21". It is called Down's syndrome because this kind of mental retardation was first traced and studied by Dr. John Langdon-Downs and hence it is named after him. It is called Mongolism because, these mentally retarded individuals will have the features of mongolian race i.e., short, broad face, round head, small lowset ears, flat nose, large tongue that protrudes from small mouth, a fold of skin at the inner corners of the eyes, short fingers, weak muscles. The child exhibits a marked degree of mental retardation with an IQ of 50 or below. It is called "Trisomy 21", which is a medical term. It is caused by extra



Down's syndrome is a congenital anomaly that produces typical facial characteristics

chromosome. There are forty seven (46 + 1, or 23 pairs + 1) chromosomes, instead of 46 chromosomes (23 pairs). The defect is caused by an extra number -- twenty one chromosome.

Mongolism is associated with increasing age of the mother and not with the number of pregnancies. A mother between the age group of 35-39 has 1.5 % chance of having a mongoloid child. A woman of 40+ has 5% chance to have this type of child.

This child will have congenital disorders, such as heart disease, umbilical hernia, bowel disorder and a chance of leukemia.

By testing a sample of the fluid from around the foetus in the womb(amniocentesis), a genetist can predict whether the baby will be born with Down's Syndrome, so that it can be terminated.

Mongoloid child is usually gentle and affectionate. It can be taught to perform routine work.

### Cloning :

Cloning is a technique of producing one or more individual plants or animals or human beings who are genetically identical to the original plant or animal or man. In short, it is the duplication process or carbon copy process.

Reproductive cloning means, creating a genetic duplicate of an existing organism. A human clone would be a genetic duplicate of an existing person.

Genes are strings of chemicals that help to create the proteins that make up our body. Genes are found in long coiled chains called chromosomes. They are located in the nuclei of the cells in our body.

In normal sexual reproduction, a child gets half of its genes from its mother (in her egg) and half from its father (in his sperm). This combination of genes is a fundamental basis for human variation and diversity.

In the case of clonal reproduction all the genes of the cloned child come from the body cell of a single individual.

The best known cloning technique is somatic cell nuclear transfer. Here nucleus from a body cell is put into an egg from which the nucleus has been removed. The resulting entity is

triggered by chemicals or electricity to begin developing into an embryo. If the embryo is placed into a women's uterus and brought to terms, it develops into a child. This child is nothing but the genetic duplicate of the person from whom the original body cell nucleus was taken a clone.

"Parthenogenesis" is an alternate cloning technique. Here, an egg with full set of 46 chromosomes is chemically or electrically induced to begin dividing and differentiating and forming into different parts of the body of a human child \*

There are three very different procedures for cloning.

## Environment :

The term 'environment' refers to such factors, in and around the individual which stimulate the individual and bring about changes in the individual physically and psychologically. The environment is classified into two categories-(1) internal environment, (2) external environment. The external environment is further classified into - (a) physical, (b) social environments. Physical environment refers to physical stimuli which act upon the individual and bring about changes in the individual. For example : light, sound, smell, taste, touch, etc., These stimuli which are around him act upon him through the respective sense organs. The 'social environment' refers to socio-cultural stimuli which act upon the individual and bring about changes in the behaviour of the individual to fit into the society to which he belongs. For example : family, peer group, school group, customs, traditions, values, morals, etc.

### Internal environment :

The internal environment refers to the prenatal environment. The nucleus with its chromosome and their genes is surrounded by a Jelly like substance known as cytoplasm'. Cytoplasm is considered as an intracellular environment. This environment influences the genes and thereby the traits they carry. In fact, what the organism becomes is determined by its cytoplasm and its heredity. Further the cells press upon one another and influence their neighbouring cells chemically and electrically. This

intracellular environment has an effect on the developing embryo. The cells in each area will develop into the respective organ. For example : the cells in a particular area develop into eye, and cells in the area of ear develop into ear. This differential development in the identical cells is due to different environmental influences that operate on the cells. Thus each cell forms an environment to the other cell. In this way growth and development depend upon the interaction of the parts within the organism.

Later on when the endocrine glands develop and pour their hormones into blood stream. another intracellular influence is produced. These hormones greatly affect the subsequent development of the individual. In fact many deformities found at birth are the resultant of hypo or hyper activity of the endocrine functioning. Other chemical characteristics of the blood are also important in the development. In addition to intracellular environment, intrauterine environment like-malnutrition of the mother, vitamin deficiency, excessive alcohol, excessive smoking, use of drugs like-narcotics and tranquilizers, chronic diseases like diabetes, tuberculosis and cancer will have their own effects. Certain temporary diseases like rubella and venereal diseases, severe and constant stress on the mother will also affect the development and growth of the prenatal infant. Consequent to this intrauterine environment the individual will be born with physical or mental handicap or both. Example, mental deficiency, cleft-palate, born-blindness, deafness etc. will manifest in the individual. These will have long range effects on the individual.

**External Environment :** The environment after birth is more complex and powerful. It involves immense variety of physical and social contacts. This is what we customarily call the environment. The social environment includes language, customs, tradition and many cultural aspects like values, moral, religion etc. Further schools, community, family, peer group neighbourhood also influence the individual. The physical environment involves physical stimuli like the food we eat, the drinks we take, the clothes we wear, the shelter we live in.

light, sound, smell, taste etc, will have their own impact on the individual.

Thus the individual from the time of conception to death is subjected to environmental influences. So we find that the continuous interplay of the heredity endowments and the environmental factors in determining the physical, physiological, social, and psychological growth and developments of the individual. So man is a product of the interplay of heredity and environment.

## RELATIVE IMPORTANCE OF HEREDITY AND ENVIRONMENT

The relative importance of heredity and environment is rather disputable because both heredity and environmental factors are equally important in the development of the individual. They interact in such a way that influence of each factor is dependent on the contribution of the other. Any single hereditary factor operates differently under different environmental conditions. In the same way the environmental conditions differ in their relative influence depending upon the hereditary factors involved. However hybrids and certain abnormalities prove the importance of heredity. Monsters prove the importance of environment.

### Heredity :

Hybrid is a product of two different species which are similar to each other. For example : A male donkey and a female horse (mare) when made to mate, the offspring will be mule, because the mule's father is a donkey and not a horse. This happens in spite of the fact that the prenatal environment for this offspring is the same as is to normal horse. If the environment is important the offspring should be born as horse.

Further some of the abnormalities like 'lobster claw', polydactyly (6 fingers and 6 toes), absence of hands and feet, squint eye, haemophilia (bleeder's disease), 'Klinefelter's syndrome' (XXY type—person appears to be male but sterile), 'Turner's syndrome' (XO type—Female but sterile), hyper masculinity

(XYY type—generally male with delinquent or criminal behaviour) etc., run in certain families. They are due to sudden alterations in chromosomes or genes and they are inherited. Many 'mutations' occur spontaneously. This mutation rate can be accelerated by artificial radiation. In addition to inherited bodily abnormalities directly attributable to mutations, there are many behavioural disorders which appear repeatedly through generation after generation in certain families. For example : 'Huntington's Chorea' (nervous affliction—twitching or more or less widespread jerking or twiching of muscles with mental deterioration), certain kind of feeble mindedness like mongolism, hydrocephaly, microcephaly etc.

#### **Environmentally produced abnormalities :**

Many abnormalities result from the defective prenatal environment. If the mother's blood stream does not supply enough calcium, abnormalities in the bones and teeth emerge. If the mother is suffering from diabetes the pancreas of her foetus works excessively. Continuation of this after birth reduces the blood sugar of the infant so much that it suffers from insufficient 'glycogen' (hypoglycemia). If the pregnant woman take thalidomide (sleeping tablet) at the time when the limbs of the embryo are forming it results in deformed limbs. In some cases hands or feet fail to develop. If the mother is exposed to X ray often during pregnancy, the infant becomes 'microcephalic. Further head injuries at birth either through prolonged pressure on the head during difficult labour or from instrumental delivery, result in 'spastic paralysis' (stiffness and impaired movement of the muscles—walking with scissors like gait), feeble mindedness, epilepsy etc. may occur. Severe oxygen deprivation at birth causes 'anoxia' which affect the growth of intelligence.

#### **Postnatal environment :**

The external environment after birth is extremely variable, and unrelated to the genes. No two individuals, living in the

same home, going to same school have the same environment. Though it appears same, their effect is different on the development of the individual. Because they meet different individuals in the same environment and are influenced differently by the same people, they develop different interests and attitudes and identify with different groups—religious, political, recreational, lingual and caste groups. As the postnatal environment is much variable and its effects so unpredictable, makes it difficult to discover the relative influence of heredity and environment on psychological development after birth. We know, that every one of us are developed out of genes and genes have no effect without normal surrounding tissues. So any differences either in physical or psychological growth and development are due to both heredity and environment.

### **Experimental studies on the importance of heredity and environment :**

In order to study the relative importance of heredity and environment on physique, intelligence, personality, and other characteristics they held either heredity or environment constant and varied the other factor. Such experiments are limited and are possible only on identical twins. In spite of the availability of twins, the environment will not remain the same psychologically.

Studies are made on relative importance of heredity and environment in the determination of physical and psychological traits. For all those studies identical twins, fraternal twins and siblings are used.

Newman, Freeman and Helzinger have made a study on the role of heredity and environment on 'height'. They studied 52 pairs of siblings, 52 pairs of fraternal twins, and 50 pairs of identical twins. They were all of the same sex. The correlation coefficient in height among siblings was 0.60, among fraternal twins it was 0.64 and among identical twins it was 0.93. The above results reveal that (a) similarity in height is maximum among identical twins but not exactly alike. (b) whereas fraternal twins are less alike and (c) in siblings the similarity is still less. (d) It is also clear that there is not much of difference between fraternal twins and siblings in the magni-

tude of correlation because, fraternal twins are no more alike genetically than siblings. So one can conclude that physical height is largely determined by one's heredity.

The same authors have worked out correlation on intelligence test scores for 50 pairs of identical twins, 52 pairs of fraternal twins and 384 pairs of siblings. The correlations obtained were 0.88, 0.63 and 0.53 respectively. From this it is clear--(a) that there is similarity between identical twins in intelligence than the other two groups, (b) similarity is least in the case of siblings, (c) though heredity plays a predominant role in determining intelligence. Environment also plays its role to some extent. That is why the correlation is 0.88 and not 1.0 with identical twins. (d) The role of heredity in the determination of physical height is greater than its role in determining psychological trait like intelligence, (e) The influence of environment is greater in the case of fraternal twins and siblings, than identical twins (f) The environmental influences are more alike for identical twins than for fraternal twins or siblings. The reason being the identical twins look, and dress alike, and spend more time together, than fraternal twins and siblings. Further parents, teachers, and others also treat the identical twins alike.

From other studies on identical twins reared apart, it is found-(a) they resemble each other more closely in physical characteristics than fraternal twins or siblings reared in the same environment. (b) They are slightly less alike in height and weight than identical twins reared together. This reveals that environment has little to do with such physical characteristics (c) Even in intelligence separated identical twins are more alike than fraternal twins reared together, but less alike than identical twins reared together. (d) The resemblance is less between pairs of reared apart identical twins in intelligence, than in height and weight.

In one study H.H. Newman has reported a case study of identical twins reared apart. Paul C and Paul O were separated at second month. Paul C lived in a small town up to 13 years, another 2 years in a larger town and finally in a medium sized city. He completed high school at 18th year and then

took up some business courses while working. His brother Paul O was adopted by a telegraphic operator. He moved from place to place with his foster father mostly in rural environment and completed high school at 18th year. After less than an year in the college he discontinued and became an assistant post master. When these twins were tested by intelligence tests at the age of 23, the difference in IQ was only 2 points. This small difference may be due to the facts— (a) common heredity and (b) study in somewhat comparable school. Whereas among other twins who had different educational opportunities, the differences in IQ ranged up to 24 points. Their study also reveals that even in persons of same heredity the difference in educational opportunity produces significant differences in the performance on intelligence, significant differences in the intelligence among the twins there were also larger differences in personality make up.

Munn finally states that identical heredity makes individuals very much alike in physique, some what less alike in IQ and still less alike in personality. With respect to IQ and personality, the effect of environmental differences is relatively large.

In another study 'Richard and Raymond' who were identical twins are quoted as an example for the importance of heredity on intelligence. When Richard was one month old he was adopted by a truck farmer. As the foster father moved from job to job Richard was forced to attend different schools, Raymond on the other hand was adopted by a physician at the age of 14 months. As his foster father was an upper middle class man his home environment and schooling were superior to those of Richard. When these two children were assessed by intelligence tests at the age of 10, the differences in their IQ was only 1.0 Richard's IQ was 105 and Raymond's IQ was 106, in spite of wide differences in the environment of these children.

In another study on the IQ of different groups of children the following correlations are obtained.

(1) Identical twins reared together	$r = 0.85$
(2) Identical twins reared apart	$r = 0.70$

(3) Fraternal twins reared together	$r = 0.64$
(4) Siblings reared together	$r = 0.50$
(5) Father-child and mother-child	$r \approx 0.50$

The above correlations indicate—(a) some heredity components in intelligence, (b) the difference in the correlation between the identical twins reared together and reared apart indicates the influence of environment.

The research evidences are there to show that whatever their origins be, the similarities of identical twins tend to persist throughout life. Similarities include traits like loss of strength in old age, thinning and greying of hairs, configuration of baldness, the type and extent of defects in eyes, ears, teeth and finally in intelligence.

Kullman (1938–1983) used twins, to study genetic factors in mental disorders and found—(1) if one member of a pair of identical twins develops schizophrenia, the chances are 86 in 100 that the other will also develop schizophrenia. On the other hand with fraternal twins, the chances are 14 in 100 to get schizophrenia. Regarding manic-depressive psychoses, the chances with identical twins are 90 in 100 and in fraternal twins the degree of concordance is significantly lower. With these conclusions, the author says such high incidences among identical twins are not only due to predisposing heredity endowments but also they are subjected to more or less similar stressfull situations than fraternal twins and siblings which precipitate the onset of the above disorders. If they are brought up in different environment, the chances are less.

Number of studies are also made by Burks (1928), on 'foster children' to know whether their intelligence resembles foster parents or biological parents. One study reveals—(1) that, adopted children resemble their biological parents in intelligence to a greater degree than resembling their foster parents. This study stresses the importance of heredity. But recent studies have shown—(1) that adopted children tend to resemble their foster parents more than their biological parents in intelligence because they live longer with foster parents.

It is generally accepted that physical traits like hair and

eye colour, body build and blood type are genetically determined. Though it is difficult, attempts are made to study psychological characteristics like intelligence, emotionality, aggressiveness etc. As it was difficult to control many variables in human beings most of the studies are made on animals. They have followed two main methods: (1) selective breeding (2) observing psychological traits in different strains, breeds or species.

### Heredity and Environment on Personality :

Genes not only play a role in determining traits, but also play significant role in determining personality. (Also see chapter on personality in part-2 of this book). People who share more genes will have more resemblance in character, attitudes and interests. Personality differences appear in early infancy in their temperament. Temperament includes moods, activity level, emotions and the variability of each. Identical twins are more alike in temperament than fraternal twins and siblings. Even when they become adolescents and adults they indicate moderate degree of similarities in personality traits. Their scores on personality tests have high correlation of 0.50 compared to correlation of 0.25 of fraternal twins. Some specific traits like "Introversion—Extroversion" will have definite genetic basis. However the contribution of heredity to personality is less than its contribution to intelligence.

Studies on the inheritance of personality comes from identical twins who have not been raised together. At Minnesota university a major study was made on pairs of identical twins who were reared apart. They assessed the "similarities and differences" on a wide variety of physiological and psychological measures of identical twins (Holden-1980). Although the data was not fully analysed, the results revealed interesting things.

Thomas Bouchard and his colleagues located and studied 23 pairs of identical twins from many parts of the world. Some were separated at an average age of six weeks. Some are raised in similar environments and some in totally different environments. Many had little contact from infancy. Some

met each other for the first time as adults at an airport.

Each pair of twins under went eight days of individual testing. They were given a battery of tests—physiological test of brain waves, heart function, allergies and other reactions. Also psychological test of interest, values, phobias and tests of intelligence and abilities. Many tests were also repeated during those eight days to assess a given factor at different times.

The twins showed surprising similarities—(a) highly correlated IQ scores, (b) Some of their life histories were full of similarities i.e. given similar names to their children, (c) Some pairs have even married and divorced in the same way. (d) One pair though brought up at different countries, and led different lives, they shared a host of idiosyncrasies such as flushing toilets before using them, reading magazine from back to front, fidgeting with other peoples rubber band and dipping buttered toast in coffee. (e) They had very similar profiles on MMPI. (f) A pair of British housewives met at an airport, but each one was wearing seven rings, two bracelets on one wrist, a watch and bracelet on the other hand. (g) One pair suffered suspected heart attack at the same time. (h) Another pair developed diabetes at the same time (i) Brain waves of twins were similar in most cases. (j) Their abilities and interests were also similar. (k) Twins share phobias and tended to have similar emotional styles. All these things suggest that genes may have a subtle, imperceptible influence on many aspects of human individuality.

H.J. Eysenck proposed that traits related to his introversion-extroversion type of dimension are linked to inherited characteristics of the "reticular formation". This part of the brain influences an individuals "level arousal". So Eysenck believes that introverts inherit more of a tendency to be aroused, "revived up" than do extroverts. Introverts have a basic need to inhibit or "damp down", their arousal. So introverts tend to avoid extreme excitement, seek out calm, and quiet conditions. They shy away from activation caused by social interaction. On the other hand extroverts genetically predisposed to be "underaroused" and are attracted to excite-

ment and social interaction. Test of introversion-extroversion do show fairly strong evidence of heritability.

Apart from similarities in their test scores identical twins show a remarkable number of subtle behavioural similarities. Even when they are reared apart, they tend to laugh alike, smoke similar number of cigarettes per day and show similar nervous mannerisms. From all these we may infer that genes may influence personality in more diverse and dramatic ways than most of us think.

## CHAPTER IV

# Sensation-Attention- Perception

### Introduction :

The physical and social environments with their inherent nature draw our attention to them. When any stimulus is attended to by the respective sense organ, it releases neural impulses. The encoded information about the object in the form of neural impulses constitute sensation. Interpretation of sense impression is perception. Thus these three functions are interrelated. They provide knowledge of the environment, so that the organism can act appropriately to adjust to the environment. So to understand behaviour we have to know these interrelated functions.

### Nature of Sensation :

It is a fact known to all of us that sense organs, are the gateways of knowledge of world around us. This knowledge does not come to us straight away from the object or objective reality. The stimuli or the stimulus from the object, stimulate or impinge the receptors of the concerned sense organ. Those receptors after being stimulated, release the neural impulses (encoded information). These neural impulses are transmitted to the concerned part of the brain. The part of the brain which receives the neural impulses, decodes and interprets the impulses, correctly. This gives the knowledge of the object stimulating. Thus the sense organs keep us aware of the state of affairs in our environment, be it internal or external, physical or social. The knowledge of the world around, is very essential for us to adjust to it effectively and efficiently.

The stimulus mentioned above is anything inside or outside the body which initiates activity of some kind. The sensory stimuli are those which activate the sense organs. There are certain stimuli which fail to stimulate us and hence we will not be aware of them except through some sensitive instruments. The effectiveness of the stimulus depends upon the nature of the stimulus, the sensitivity of the sense organ and the mental set of the individual.

A stimulus which is sufficiently strong enough acts upon the receptors of the concerned organ and make them release neural impulses or electrochemical waves. These neural impulses constitute *encoded information* about the stimulating object directed towards the brain for decoding and interpretation, so that the individual becomes aware of it. So *sensation is nothing but the encoded information about the object or the objective reality which is in the form of neural impulses*. The sensations vary in number, intensity, extensity and quality. There are many kinds of sensations as there are sense organs. It was believed that there are five kinds of sensations such as, visual, auditory, gustatory, olfactory and cutaneous sensations. Now it is found from investigations that there are three more sensations such as kinaesthetic, static and organic. Each sensation has its own sense organ. A brief account of each sensation is given in this chapter.

### Steps involved in Sensation

There are four essential steps involved if stimulation is to lead to sensation. (Floyd L. Ruch, 1970).

(1) *Stimulus* must be applied internally or externally. A stimulus is some kind of radiant, mechanical or other energy which activates the receptors of the concerned sense organ.

(2) The stimulus must stir certain *receptor cells* or nerve endings into activity. Usually a receptor cell is activated only by a particular form of energy. Ex : visual receptors are stimulated by light waves, auditory receptors are stimulated by sound waves and so on.

(3) The neural impulses released must travel from the receptor cells to brain through nerves.

(4) Activity must be aroused in the sensory areas of the brain producing conscious sensations. Each sensory activity has its own special area in the cerebrum or brain.

If any one of these four steps is missing there will be no sensation at all.

### Characteristics of Sensations :

The sensation whether it is visual or auditory or gustatory or any other form has certain fundamental characteristics common to all. Some of them are : (Boring, Langfeld and Weld 1963, Geldard, 1962).

(1) Sensation is a *change* brought about in us by a stimulus. We may call it as *stimulation*. It makes us aware of certain facts either in the world outside or within us. They come in the form of air waves, light waves or heat waves etc.

(2) For sensation to be effective it must possess some amount of *intensity*. It should not be very faint or very intense. For ex : a very faint sound may not be heard or very faint light may not be seen. On the other hand if it is very intense beyond certain limits it gives rise to some other experience than what it has to. For ex ; sound of very high intensity causes pain in the ear instead of causing the experience of sound.

(3) The point below which a sensation has no effect is known as *limen* or lower limit. The point above which it becomes painful is known as upper limit. In between these two limits there are many sensory intensities.

(4) The upper and lower limits are also known as the *threshold*. The stimulus which is below the threshold cause no response. It is known as *subliminal stimulus*. Two or more subliminal stimuli, combining together, may produce a single strong reaction. This phenomenon is known as the *summation of stimuli*.

(5) *Latency Period* ; It is the time that lapses between the stimulus presented and the responses shown. The stimulus takes a certain length of time i. e.. roughly 0.005 seconds to 0.1 second to arouse a sense organ. Then it takes time to arouse nerve fibres that lead to the brain. Further, the brain connections, the motor nerves, and the muscles also takes

time to respond. Thus there is bound to be lapse of time between the awareness of the sensation and consequent initiation of action. Usually the response and the stimulus appear to take place simultaneously but there is always some lapse of time which is known as latency period. This can be measured by reaction time apparatus.

(6) *Duration* : If a stimulus is to be effective it must be presented for a certain length of time. It should be neither too short nor too long. If it is too short, it does not act upon the sense organ effectively and produce the desired sensation. If it is too long the concerned sense organ either gets fatigue or there will be adaptation in the sense organ. And hence there will be no sensation and no response. For ex : continuous presentation of an odour or sound for a long period causes negative adaptation and will not provoke the expected response.

(7) *Extensivity* : Extensivity refers to the amount of space that the stimulus occupies. Infact many sensations will have extensivity. Bigger stimulus occupies larger space and smaller stimulus occupies smaller area. Example : Hot water bath occupies larger space in the skin and a pin prick occupies smaller space in the skin. High intensity of sound occupies larger area of the basilar membrane, and low intensity occupies smaller area of the basilar membrane.

(8) *Quality* : Every sensation has quality in addition to quantity. The quality tells us the kind of sensation and the quantity refers to the amount of sensation. For example : two colours of same saturation value and brightness value may still differ in colour. Similarly tones of different instruments though they are equal in intensity and frequency of sound waves differ in their tonal quality which are easily distinguishable.

Thus sensation whatever be the modality they belong to have some common characteristics.

#### **Differences between Sensation and Perception :**

Normally sensation and perception are two aspects of a single process. We can only "think" of them separately but

cannot "experience" them separately (Rex & Margaret Knight) It is rather difficult to understand the differences between sensation and perception because the two are inseparable and always go together. The difference can only be discussed at theoretical level. However an effort is made to show the differences between the two.

1) "sensation" is an experience, that an individual will have, when his sensory area is stimulated by coded neural impulses (message), which are transmitted by the given sense organ to the concerned sensory area through the sensory nerves as and when the sense organ is stimulated by either external or internal environment. Whereas "Perception" is interpretation of the sensory experience by the association area of the cortex in collaboration with sensory area, and in the background of the past experience, present mental and physical states of the individual.

2) A sensation begins with the stimulation of the sense organ and ends with the interpretation of the sense experience -perception.

3) A sensation by itself cannot bring about the experience of an object, It is the psychological processes which interprets the sensation, gives the knowledge of the object- perception.

4) "pure sensation" is a primary passive mental process, which is the resultant of the external stimulating energy, whereas "perception" is an active process of grouping and organising the sensory experience and its interpretation in the background of past experience.

5) A sensation by itself cannot give us complete and meaningful experience and it cannot independently lead to perception. In addition to sensation a number of symbolic processes like images, memories, revival of a past experiences etc. together cause perception. In short the activity of converting a sense impression into awareness of some meaningful situation is called perception (Mrs M. s. Warthy/1968)

6) The sensory information merely provides "raw data". The data then combined with previous information and with thought processes to create the world we actually experience

Table showing the sensation, with corresponding sense organ, receptors, cortical area, stimulus and sensory quality :

Stimulus	Sense organ	Sensory quality	Lobe involved	Sensation	Sensory quality
Light waves	Eye	Rods & cones	Occipital lobe	Vision	Colour
Sound waves	Ear	Basilar membrane and organ of corti.	Temporal lobe	Audition	Tones and Noises
Soluble chemical substance	Tongue & mouth	Taste buds	Temporal lobe	Gustation	Sweet, salt sour, bitter.
Gaseous substance	Nose	Epithelium	Temporal lobe	Olfaction	Odour fra. grant, spicy etc
Pressure, temperature and pain	Skin	Meissner corpuscles, Krause end bulb. Ruffini cylinders, and free nerve endings.	Parietal lobe	Cutaneous	Touch, cold warmth and pain
Movement	Tendons, joints (muscles)	Muscle spindles Golgis tendons Pecinlion corpuscles.	Parietal lobe	Kines thesis	Movements of limbs, direction, weight
Body position	Non-auditory labyrinth. Portions of gastro intestinal track.	Hair cells of crista ampullar. Specialised & free nerve endings	Cerebellum Parietal lobe	Static or equilibrium. Organic sensation	Posture of the body Pain, pressure, hunger etc.
Churning of the wall of stomach					

(adopted from Frank A. Goldard 1962)

"perception". (Morgan and King, P. 336)

As William James puts it "part of what we perceive comes through the senses from the object before us, and another part — always comes out of our own head"

Boring, Langfeld and Weld puts it thus (P. 250) : "sense organs send messages to the brain through nerves. When these messages merge at higher centres of the nervous system organize themselves and modify one another through interaction and associations, cause "perception". If this message remain isolated and apart with no mutual influence become "Sensation.

### Visual Sensation

Light is composed of electromagnetic waves. Those waves are nothing but radiant energy emanating from a source ultimately from the sun. This energy faces various matters, and is affected by them in a number of ways. For example : some objects slow down, some refract, some absorb and some reflect this energy. When it enters the eye it becomes a visual stimulus.

Human eye reacts to electromagenetic waves ranging in length from 400 to 700 milimicrons ( $m\mu$ ) The waves which are beyond these two limits fail to excite or stimulate the eyes of human beings! Though our visual receptors are sensitive to the above range of wave lengths, they are not equally sensitive to all parts of the visual band. The maximum visibility ranges around  $550m\mu$  and it is minimum near  $400m\mu$  and  $700m\mu$

### Purkinje Phenomenon

The sensitivity of our eyes to different regions of the spectrum changes from day to night. During the day our eyes are maximally sensitive to wave lengths around  $550m\mu$  and at night they are sensitive to the range around  $510m\mu$ . Thus the point of maximum sensitivity shifts slightly towards the short end of the spectrum from day to night. Naturally there is a change in a relative brightness value of different colours. For example; Red and orange are bright in day light become dim at dusk or at night, whereas blue and violet are dull in the day light become bright at dusk or at night. This shift in

the brightness value of colours is known as *Purkinje phenomenon* because it is Purkinje a Czech physiologist who demonstrated this change over in brightness value of colour vision from day to night in 1825, (Whittakar 1970). To demonstrate this phenomenon, take two colour bits-one *red* and another *blue*. Look at these two colour bits in the day light. Red appears very bright and blue appears dull. See the same two colour bits at night, red appears dull and blue appears bright. Similarly yellow and green show the shift in brightness value from day to night. This shows that the eye is a selective receiver. It is more efficient at perceiving some colours than others, and this selectivity changes at different levels of light.

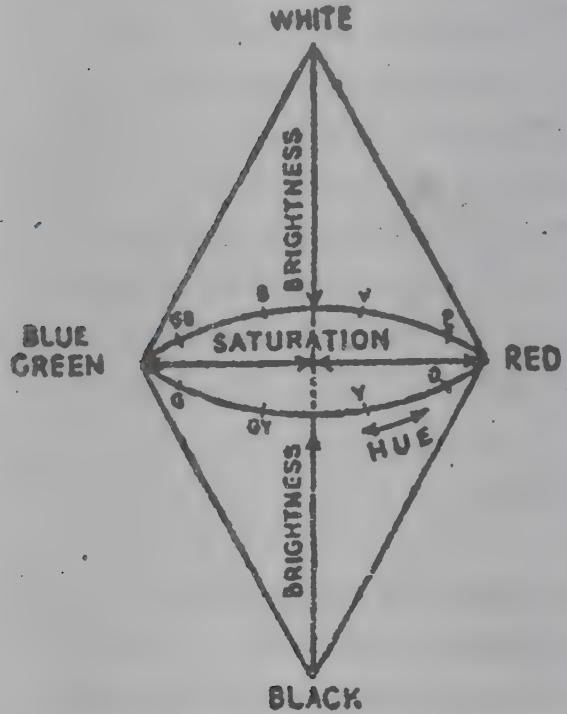
### Colour vision :

The colours we see are not inherent in the objects, but depend upon the wave length which stimulates our eyes. So the colours perceived are only a sensory experience or visual stimulus. Whatever be the interpretation of colour vision every colour has three visible aspects *viz Hue*. (Red, green, blue, yellow and so on). *Brightness* (how light or dark the colour is) and *saturation* (how rich or deep is the colour). These visible aspects are related to three physical properties of electromagnetic radiation. *Hue* or the colour depends upon the *wave length* of the light. So changes in the wave length causes change in colour vision. Red has the longest wave length, violet has the shortest wave length, and green has medium wave length. *Brightness* of a colour depends upon the *energy of the amount of radiation* that light waves carry. If the energy is more, brightness is more and if the energy is less brightness is also less. *Saturation or Purity or Richness* of the colour depends upon *homogeneity* of the radiation i. e., the number of wave lengths combined or put together. So the increase in the number of same wave lengths increases the saturation value of the colour.

## Colour Solid

Colour solid or pyramid is a schematic presentation of the interrelationship among the three qualities of a colour. In the colour solid the different hues found in the spectrum are represented around the central axis. Saturation is represented on the border of the circle or on the periphery. Brightness is represented by a line running through the centre of the solid from white to black with neutral grey at the midpoint. As the saturation value of the hue increases it moves towards the edge of the circle. Then it appears to be highly saturated colour. On the other hand as the saturation decreases, the hue moves towards the central axis. In the same way as the brightness value of the hue increases it moves towards white and as brightness decreases it moves towards black. In other words as the brightness value reaches the maximum point, the hue becomes completely white and the decrease in the brightness to the minimum makes the hue black. If all the hues which are on the periphery move towards the central axis they become neutral grey. Thus the colour solid explains the interrelationship of the three qualities of any colour.

Figure 16. Colour Solid



## Colour Mixture

There are only four colours which are pure and primary. They are called psychologically *unique* colours. They are red, green, blue and yellow. All the other colours are mixture of these four primary colours in different proportions. Colour mixing can be made with the help of colour mixing apparatus. In colour mixing we find three laws (Munn-1966). They are :

(1) Mixing of two complementary colours in a certain proportion produces the neutral grey. The brightness value of this resultant grey will be in between the brightness value of the two colours mixed. Ex : Red and green mixed together give rise to grey. Similarly blue and yellow mixed together also give rise to grey. Here red and green are complementary colours. Similarly blue and yellow are complementary colours.

(2) Mixing of two non-complementary colours in a certain proportion gives rise to a third colour whose brightness and the saturation value is between the two colours mixed. Ex: Red and yellow when mixed together give rise to orange colour and Red and blue give rise to purple.

(3) The mixture of mixtures of the complementary colours also give rise to grey; whose brightness is the average brightness of the total mixture. Ex : Red and green, blue and yellow when mixed together give rise to grey of average brightness.

The painter, artist, textile industry and others who are interested in colour designing make use of these principles.

### Colour Weakness and colour Blindness

Some are very poor in distinguishing different hues and different shades of the same hue. They can be classified into (1) colour weak and (2) colour blind. Those who have *colour weakness* can see various colours but have difficulty in distinguishing the hues of different shades. For example : red, magenta, maroon etc. They perceive all these colours only as red. The *colour blind* people fail to perceive colours. These people can be classified into two subgroups viz (a) *Totally colour blind* (b) *Partially colour blind*. The totally colour blind people fail to perceive any colour. All colours look grey with different degrees of brightness. For the the hues on the spectrum are equivalent to a series of grey. It is on the basis of the brightness differences they differentiate colours. Such people are very rare. Whereas *partially* colour blind are more among colour blind people. They are either red blind or green blind, or red green blind or blue blind or yellow blind or blue-yellow blind. Generally red-green blind are more in number than blue-yellow blind. Red-green blind confuse

red and green when the brightness value of both is held constant. So also blue and yellow blind confuse one for the other when brightness is held constant.

Colour blindness is an abnormality and it is a sex linked trait mostly found in men. This colour blindness is attributed to some defect in the cones or in their neural connection. There are many tests of colour blindness, but the most popular and convenient is the Ishihara colour blindness test. The other colour blindness tests are—(1) Colour mixing test, (2) Spectrometer test, (3) Stilling's pseudoisochromatic tables (4) Holmgren's wool test, (5) Edridge-Green lantern test, and (6) Nagel cards.

Ishihara test has 38 colour plates of colour patches of which 25 plates have some numerals and 13 plates have some out lines to be traced by the individual. The latter 13 plates are to be used only when the individual fails to read number of the first 25 plates. If an individual reads 17 or more plates correctly the colour vision is said to be normal. If 13 or less number of plates are read correctly the colour vision is said to be deficient [Ishihara colour blindness test—manual]. Colour blindness test is used in the selection of pilots, drivers, signal men and employees for textile industry, pigments factory etc.

### **Blind Spot :**

Blind spot is a small area in each eye which is completely blind. This area is completely free from rods and cones and hence it is not sensitive to visual stimulation. It is located in the place where the optic nerves leave the retina to the visual cortex. The area of the blind spot is 1.5 mm. in diameter. It is located about  $12^{\circ}$ — $15^{\circ}$  to the nasal side of retina and almost in the horizontal plane (Boaz 1968). Under normal conditions we do not experience the blind spot because what is missed by one eye will be covered by the other eye. However the existence of blind spot can be demonstrated by using perimeter.

### **Retinal zones and colour zones**

The field of vision is the total area perceived by the retina. It extends vertically  $100^{\circ}$  and horizontally  $145^{\circ}$ . The retinal

zones can be roughly divided into three zones—(1) inner zone (2) middle zone (3) the outer zone (Seashore C. E—1927).

The innerzone is the foveal region wherein cones are thickly distributed. Hence it perceives both the colours and colourless sensation. Being the area of clearest vision, red and green colours are perceived.

The middle zone is next to the inner zone which is sensitive to blue and yellow but blind to red and green. The outer zone is completely colour blind and it perceives only grey. So any colour that stimulates this area will be perceived as grey.

Thus we find that the red and green areas are the narrowest of all and they are in the foveal region. Of these two colour zones red zone is wider than green zone. Again in the middle zone the blue zone is wider than the yellow zone. These colour zones vary with the illumination, brightness and saturation of the colours used, size of the colour bits used, age of the subject, diseases etc. These colour zones of the retina can be mapped by using perimeter and colour bits.

### Afterimage

Afterimage is the after sensation experienced by an individual for a very short period soon after the cessation of the stimulus. An after image is apparently the same as original sensation caused by the stimulus. The after images are mainly of two types—(1) positive after images and (2) negative after images.

Positive after images are due to continuation of the receptor and neural processes even after the stimulus ceases. These images will have the same colour and brightness as the original stimuli. They last for a few seconds and are seldom experienced in every day life. This can be demonstrated as follows: *Look at the sun for some time. then Immediately turn your head and look at a blackboard or black surface. You will see the same bright sun for some time.*

When the positive after image of the sun disappears, negative after image takes its place. This after image is complementary to the original stimulus in both colour and brightness. So, if the original stimulus is bright yellow, the negative

after image is dark blue.

The after image, whether it is positive or negative depends upon the intensity, brightness and duration of the original stimulation. In every day life after images go unnoticed because the intensity and duration of the original stimulation will not be sufficient to produce pronounced after images. After image can be demonstrated by using Wallin's after image cards.

### Contrast Phenomena :

It is a tendency for the sensation of any colour to induce the sensation of its complementary though the complementary stimulus is not actually present. This fact is evident in the phenomena of successive and simultaneous contrast.

*Successive contrast* : If we fix our eyes on a coloured patch for about 20 seconds and then turn our eyes to the white or neutral grey surface we see a patch of the same shape and size as the original, and of the complementary colour. This secondary patch is known as negative after image. So negative after image is often referred to as an example of successive contrast. This phenomenon is probably due to retinal fatigue.

*Simultaneous contrast* : If a small piece of neutral grey paper is placed on any coloured background, it usually appears faintly tinged with the complementary colour of the background. Ex ; the grey bit on the red appears slightly greenish and on yellow background it appears slightly bluish. The simultaneous contrast effect is usually seen immediately, if it is seen at all, but no prolonged staring is necessary. The cause for this phenomenon is unknown. However, this phenomenon has practical value. It is often used in stage lighting. Yellow light at the edge of the stage makes grey shadows to appear bluish and make blue objects more blue. Similarly artists and dyers make use of the principle of this phenomenon.

### Light and dark adaptation :

In the light, our eyes become light adapted and in the darkness they become dark adapted. When we enter a movie theatre during the day time the whole thing looks dark and we

find it difficult to see around. After a short time in the theatre we begin to adapt to the darkness and so everything gradually becomes visible. So the process by which the eyes get prepared to see things in the darkness is known as *dark adaptation*. When the eyes are adapted to darkness, we do not see the colours, because the rods take over charge of the vision from cones. This change over from cones to rods takes some time. Dark adaptation takes more time than light adaptation.

On the other hand, adaptation of our eyes from darkness to sudden light is known as *light adaptation*. After staying in the darkness for an hour or two, if we see bright light suddenly we feel to be blind for a moment. We cannot open our eyes and see any thing. Within a few seconds the dazzling light or the glare disappears and our eyes adapt to the light and see things. If the change in the brightness of the light is great, in addition to the dazzling effect of the light we experience pain. This light adaptation is quicker than dark adaptation, because the cones take over charge of vision from rods quickly.

### Visual acuity :

Visual acuity is the ability to perceive or see the fine details and to perceive the differences in the two impressions which are very close to each other. The acuity is at its best in the fovea and becomes gradually worse as the image moves towards periphery. It increases with the amount of light, nearness, orientation, colour of illumination etc. Visual acuity can be measured by finding out how small an object can be seen at a given distance or how great a distance a given object can be seen from. This test is very useful for the selection of employees for watch factory, small electronic equipment factory etc.

### Visual Space Perception :

Perception of size, position, distance and depth of an object or objects is technically known as space perception. These aspects or attributes of an object are perceived in terms of different visual cues. Some of them are physiological and

some are psychological. We judge the size of an object in terms of the magnitude of the retinal image, its relation to other objects and our knowledge of the object. The size of an object, within certain distance, appears to be the same, in spite of the decrease in the size of visual image. This phenomenon is known as *size constancy or perceptual constancy*. Similarly, we experience colour constancy, shape constancy. Location constancy, illumination constancy and brightness constancy are discussed under perception. The perceptual constancy depends upon the visual acuity. Within the limits of acuity the size, shape and colour of an object appears to be the same, though the retinal image changes in its size, shape etc. with distance. This is because, the perceptible difference in the retinal image is beyond the comprehension limits. The object beyond the distance of constancy appears small corresponding to the size of the image. Apart from the retinal image, the context is also an important factor in the judgement of size..

#### Depth and Distance :

Generally the pictures we see are two dimensional. In the sense they have length and breadth but not depth. The factor of depth refers to third dimension. The object we see in reality or the persons and animals we see, have depth in addition to length and breadth. The perception of depth is possible because of *retinal disparity*. In the sense, the human eyes which are located in the front at a fixed distance get slightly two different impressions of the same object simultaneously. That is, the right eye gets the impression of the right part of the object and the left eye gets the impression of the left part. These two get slightly different impressions of the object : which stimulate the visual cortex simultaneously will be interpreted in such a way, that the individual experiences depth. The perception of depth depends upon the factors like maturation of the concerned nervous system, the concerned structure, learning and accommodation mechanism of the eyes.

The *Perception of the distance* is correlated with retinal image and the corresponding neural impulses transmitted to

the visual cortex. So we neither perceive depth nor the distance but it is only a reaction of visual cortex to the pattern of stimulation. The perception of depth and distance depend upon many psychological and physiological cues, maturation and accommodation of our eyes.

### **Psychological Cues :**

The psychological cues are effective whether we see through one eye or both the eyes. The monocular and binocular cues which are correlated with retinal image, aid perception of depth and distance. Some of the cues correlated with retinal image are—size of the image, interposition, linear perspective, aerial perspective, shadow and relative movements (Boring, Langfeld and Weld 1963)

(a) *Size of the image* : The retinal image is large if the object is near, and small when it is far away. If the object is beyond the limits of constancy, the factor of constancy does not operate. On the basis of the size of the image we perceive the distance. In fact it presupposes the knowledge of the actual size of the object.

(B) *Interposition* : This refers to contour lines of the overlapping objects. The object whose contour line is continuous at the point of overlapping is perceived as closer and object whose contour line is lost or covered at the point of overlapping is perceived to be away.

(c) *Linear perspective* : The decrease in the size and separation of objects when they are at longer distance is often used by artists to represent the distance in the picture. The lines converging as the horizon is approached gives the impression of longer distance. Ex : The space between the railway lines appears to decrease with the increase in distance.

(d) *Aerial perspective* : The object which is near appears with more details. The one that is away appears with less details. So the loss of details in an object or loss of clarity in the perceived details of an object due to fog, smoke or air through which it is seen is a cue for the perception of distance. Ex : perception of a hill from near appears with more details and from far away appears with less details.

(e) *Shadow* : Shadow is a depth cue. Light and shadow reveal the depth of an object. Shadows are of two types— (1) Attached shadow, (2) Cast shadows. If the shadow of an object falls on another object nearby, it is known as cast shadow. Ex : The shadow of a tree falls on the ground or on another object nearby. This reveals the spatial relationship between the objects. On the other hand, if the shadow of a part of an object falls on the other part of the same object it is known as attached shadow. Ex : The shadow of the nose falls on the face and gives the impression of depth. This principle is used by an artist to bring out the impression of depth in his pictures.

(f) *Movement* : The relative movement of object is an important cue in judging the distance. The movement of an object nearby appears to be faster than the same movement of the object at a distance. On the basis of this cue we judge the distance of an object. Ex : A car running at a speed of 60 km close to us, appears to be moving very fast but the same car moving with the same speed appears to be moving slowly when it far away from us.

### Physiological cues

Some of the physiological cues which help perception of depth and distance are— (a) Accommodation, (b) Convergence (c) Retinal disparity. [Boring, Langfeld and Weld 1963]

(a) *Accommodation* : Depending upon the distance of the object on which we fix our attention, the lenses of our eyes change their curvature. This adjustment of the lens is controlled by ciliary muscles which are holding the lens on either sides. The corresponding neural impulses of this adjustment provide the visual cortex, the cues to perceive the relative distance of the object on which our eyes are fixed.

(b) *Convergence* : Our eyes converge (turn inward) more when we see objects nearby than the objects far away from us. These reactions are controlled by the muscles attached to the eye ball. The nerve impulses thus released serve as distance cue.

(c) *Retinal disparity* : As mentioned earlier in this chapter the right eye perceives the right side of the object

more clearly than the left eye. Similarly the left eye perceives the left side of the object more clearly than right eye. Thus the difference in the impressions obtained by both the eyes simultaneously is technically known as *retinal disparity*. This provides an important cue for the perception of depth or the third dimension of the object. The same principle is followed in the construction of the stereoscope and three dimensional pictures. In three dimensional pictures, two slightly different pictures are taken simultaneously by two cameras having the distance between the two, which is equal to the distance between the two eyes. When these two pictures are projected simultaneously on the screen they produce the effect of three dimensions.

## AUDITION

Every object in the world has elastic body to some extent. When the object is hit or disturbed, it starts vibrating. These vibrations disturb the air around in such a way that they compress and release the air rhythmically which in turn produces the sound waves.

The sounds are generally classified into (1) *Tones* and (2) *Noise*. The tones are smooth and organised. Noise is rough and disorganised. Noise is caused by non-periodic waves which strike the ear drum at irregular intervals. Whereas tones are caused by periodic waves which strike the ear drum at regular intervals. Periodic waves may be either periodic pendulum or non-pendulum in composition. Periodic pendulum waves produce pure tones, whereas periodic non-pendulum waves produce compound tones.

Every sound we hear has two qualities: (1) amplitude and (2) frequency. *Amplitude* refers to the strength or the amount of energy the sound waves carry. Whereas the *frequency* refers to the number of sound waves produced by the object per second. Unlike the light waves, the sound waves require some media like air, water, bone, metal etc., to carry them from place to place. Sound travels at a speed of 331.3 meters per second. The human ear is capable of receiving 20 to 20,000 cycles per second. Sounds beyond these two limits are not audible. It is

found from studies that a few people fail to hear beyond 16,000 cps. As the frequency approximates 20,000 cps, more and more people fail to hear. Around 20,000 cps, practically every individual fails to hear any sound. Though the lower limit is 20 cps, some people can hear even 15 cps. The sensitivity to notes of high pitch is at its maximum in early life and this begins to decrease from the age of 25 years. It is found from the studies that people become more and more deaf with the advance of age and deafness is more among men than among women. It is also found that there is *high tone deafness* in the old age. The progressive loss of hearing of high tones with age is known as *presbycusis*;

### Some of the auditory phenomena

In audition we come across a few auditory phenomena, such as pitch, loudness, timbre, beats, combination tones, and masking.

#### Pitch

Pitch of a sound is the psychological experience which depends upon the frequency of the sound waves (per second) reaching the ear. High pitch is correlated with high frequency and low pitch is correlated with low frequency of sound waves. In addition to sound waves, pitch is also affected by the intensity or the loudness of the stimulus. That is why low pitch becomes still low if loudness is increased beyond certain limits. On the other hand high pitch can be made still higher if its loudness is increased.

Pitch discrimination or power to distinguish between notes of different vibration rates, varies widely from individual to individual. This pitch discrimination is most accurate within the range of about 500 to 5,000 cps. Just as eye is most sensitive to wave-lengths of middle range of the spectrum, ear is also most sensitive to sound waves of middle range. So within this range most people can distinguish differences of about 0.3 per cent of frequency ie, one can distinguish between two notes whose respective vibration rates are 1,000 to 1,003 cps. This ratio holds good up to 5003 cps. Beyond

this the difference of 0.5 per cent between the two notes is necessary to distinguish.

### Loudness

Loudness depends upon the amplitude of the vibration. The amplitude refers to the amount of pressure of energy involved in the vibrating stimulus on the ear. The vibrations of the tuning fork will have maximum amplitude at the beginning and it decreases gradually up to zero point as the prongs of the fork come to rest. Correspondingly, the experience of loudness decreases. The psychological Intensity or the loudness increases as the stimulus intensity increase and it decreases as the stimulus intensity decreases. If the intensity of the sound is increased beyond certain limits it causes tickling sensation in the ear in addition to the experience of sound. If it is increased further it causes pain. People who are exposed to moderate loudness for a long time show measurable deafness.

### Timbre

Timbre refers to the characteristic quality of different instruments, which produce the notes of different quality. Timbre is a matter of overtones. Every instrument in addition to one *fundamental tone*, produces a number of overtones or partials. Each partial is an exact multiple of the fundamental tone. For example : If the frequency of fundamental tone is 100cps, the first partial is 200 cps. second partial is 300cps and so on. It is the number and strength of partials that give, each instrument its peculiar timbre. Tuning fork gives a perfectly pure tone but no musical instrument does so. Flute is nearest to pure tone and so it sounds thin and colourless when played as a solo instrument.

### Resonance

Different instruments not only produce different overtones but also have different resonating qualities. That is, each instrument enhances a certain overtone and deaden the other overtones. For ex : One instrument makes a high overtone predominant and other overtones less predominant. Different instruments are constructed to provide different resonance at different times depending upon the needs of the moment. Thus we find difference in overtone which gives different musi

cal instruments their characteristic sound quality or timbre. This can be demonstrated by using sound filters. All instruments sound alike if overtones are filtered.

### Beats

If two fundamental tones of slightly different frequencies are produced simultaneously, a pulsating sensation known as beats occur. The number of beats per second is equal to the difference between the two frequencies. Ex : If two tuning forks of 256 and 258 cps are activated simultaneously we hear two beats per second. One can hear two periodic fluctuations in loudness per second. The physical basis of beats is the difference in the phase of two sound waves.

### Combination tones

If two tones of different frequencies are activated simultaneously they produce many combination tones, such as *difference tone, summation tone and inter tone.*

*Difference tones* : If two tones of 200 and 300 cps are produced simultaneously, a tone of 100 cps is audible in addition to the other two tones of the above two frequencies.

*Summation tone* : Summation tone is a third tone which is equal to the sum of the frequency of the two original tones. This summation tone is 500 cps.

*Inter tone* : This tone is exactly half of the two frequencies put together. The frequency of which is 250 cps. Though these combination tones are produced, they are not perceived by all. Only the person with musical aptitude can perceive them.

### Masking

A tone or noise may make another tone inaudible or mask the other tones. This is an usual experience in every day life. Masking effect can be determined by establishing the audible threshold of a tone first and then introducing another tone (Masking tone) and then measuring the increase in intensity necessary to make the first tone audible again. Masking is greater when the primary and secondary tones are close together in frequency. Low tones have greater masking effect than higher tones. Masking is a major problem for the audiologist, the radio engineer, the musician, factory worker, and many

others.

## Localization of sounds

Localization of sound refers to locating the direction of sound from where it comes. The power to locate the source of a sound depends largely on our use of various auditory cues such as, intensity, phase of the stimulus, difference in time, and familiarity of the source etc. Localization of sound in every day life greatly depends upon familiarity with the source. For example: When we hear the humming sound of an aeroplane we look above, and when we hear the sound of an automobile horn we look at the road because we associate the sound heard with the source. This expectation is of great help to the movie industry.

Sounds from left and right sides can be located easily and accurately, because the sound from the left side reaches the left ear by 0.03 mile seconds earlier than the right ear. Secondly the intensity or the loudness is slightly more when it reaches left ear than when it reaches the right ear. Thirdly phase of the sound wave that strike the left will be different from that of the right ear. In addition to these factors visual cues also aid to locate the direction of sound. Whereas sound from top, bottom, front and back are difficult to locate. Because the above factor will be the same for both the ears. This can be demonstrated in the laboratory with the apparatus called *sound cage*.

## Theories of hearing

A number of theories have been offered to explain various auditory phenomena but none of them are adequate. Some of them are: (1) place theory, (2) frequency theory and (3) volley theory.

(1) According to *Place theory* every sound has a specific location within the cochlea, which responds whenever sound acts on it. Some sound in the basilar membrane are responsive to high pitch and some other area is responsive to low pitch. So pitch depends upon the part of the basilar membrane which gives maximal response to some frequencies of vibrations. Whereas loudness depends upon how much of basilar mem-

brane is activated. If the intensity is more, larger area is activated and if intensity is less, smaller area is activated.

(2) According to *frequency theory* the sound waves of 1,000 cps release 1,000 neural impulses per second, and transmit them to the brain. So pitch depends upon the frequency of nerve impulses reaching the brain. Whereas loudness depends upon the number of auditory fibres activated. The drawback of this theory is that it cannot account for pitches of higher frequencies.

(3) According to *volley theory* pitch depends upon a group of neurons fired in volley or squads. Higher pitch fires more number of nerve fibres simultaneously and release impulses correspondingly. Similarly loudness depends upon the number of auditory nerve fibres stimulated simultaneously. This theory explains auditory phenomena satisfactorily.

### STATIC SENSITIVITY

The organ concerned with static sensitivity is vestibular organ or non-auditory labyrinth which is located in the inner ear. It provides us the knowledge of equilibrium or the position of the body and its movements. This organ is greatly aided by kinaesthetic sensitivity. This sense organ responds to the changes in the position and the rate of rotation of the head. When head moves up or down, left or right, the pressure exerted on the fluid will be transmitted to the hair cells of crista. The released neural impulses will be transmitted to the concerned area of the brain. The interpretation of these impulses provide us the knowledge of the body posture and movements. The vestibular receptors are responsible for motion sickness. The congenital deaf mutes do not experience motion sickness at all.

### KINAESTHESIS

The structures concerned with kinaesthetic or muscle sensation are pectorion corpuscles, golgi's tendons and muscle spindles which are distributed in joints, tendons and muscles. These structures provide us the knowledge of the portion of the limbs, the complicated muscular movements, the weight of an object etc. It is with the help of these structures we can assume any posture, can touch any part of the body.

even when eyes are closed, can lift an object and find its weight, can walk along the street without paying attention to, can carry on typing, knitting, can open the door in the darkness, can drive a vehicle and can make various complex muscular movements as under dance, swimming and acrobatics. When different muscular movements are made the pressure exerted on the structures (receptors) release the neural impulses to the concerned centre of the brain and provide us the knowledge of various muscular movements.

### GUSTATION

The structures concerned with tastes are papillae of the tongue. Each papillae contains about 200 taste buds which are served with gustatory nerves. The taste buds at the tip of the tongue are concerned with sweet, the entire tongue is concerned with salt, those at the back are concerned with bitter, and those at the sides are concerned with sour.

The stimulus must be in the form of liquid or if it is solid it should dissolve in saliva to stimulate the receptors and make them discharge the neural impulses. The interpretation of the neural impulses will provide us the knowledge of the taste.

There are four primary tastes—sweet, sour, salt, and bitter. All the other tastes are the combinations of these four primary tastes in different proportion. This sense organ helps to eat the food suited to the organism and to reject the one unwanted. Thus it provides the knowledge of the world in its own way and helps us to adjust to it.

### OLFACTION

Olfaction refers to smell. The important structure concerned with smell is olfactory epithelium. The stimulus must be gaseous in form to stimulate the receptors and to make them discharge neural impulses, whose interpretation will be experienced as smell. This sense organ puts us on guard when food stuffs are unfit to eat. It also helps us to select the suitable food stuff.

Olfactory stimuli have been classified into six primary odours such as fragrant, fruity, spicy, putrid, (rotten) resinous (gumlike) and burnt smell. The list varies from investigator to investigator. People vary a great deal in their sensitivity to

odours. Some have no olfactory sensitivity at all. This abnormality is known as *anasmia*. Some are more sensitive and some are less sensitive to smells. This can be measured by using *double alfactometer*. It is said that the olfactory sensitivity will be more before the onset of menstruation and during early periods of pregnancy. Any way this sense helps us to know the world around us within its sphere and to deal with it effectively.

### ORGANIC SENSITIVITY

Organic sensitivity is nothing but diffused feeling which can be located seldom with accuracy. No special or specific receptors mediate this sensation. However it is said to be the sensitivity of the visceral, excretory and other internal organs of the individual—such as stomach, intestine, kidneys, throat, lungs, heart etc. The activities of these internal organs excite sensory fibres and conduct neural impulses to the concerned area of the brain, which provide us the knowledge of thirst, hunger nausea, intestinal tension, sex craving, thrill, suffocation etc. These feelings are reduced to a varieties of pressure pain and temperature sensitivity. Thirst is associated with dryness in the mouth and throat. Hunger is associated with pressure and pain caused by stomach contraction and nausea is associated with aches, pains and dizziness. The organic activities contribute much to motivation than to experience. And they are particularly concerned with maintaining homeostasis. That is, removal of carbondioxide from blood stream, maintaining body temperature, restoring water deficit etc, to maintain equilibrium.

### CUTANEOUS SENSATION

Cutaneous or skin sensations are—touch, heat, cold, and pain. The sense receptors concerned with these sensations are respectively, meissner corpuscles, ruffini cylinders, krause-end bulbs, and free nerve endings. Whereas pecinian corpuscles are concerned with deep pressure. All these receptors are embedded in the dermis (inner layer of the skin.)

Layman thinks that the entire area of the skin is sensitive to all kinds of cutaneous sensations. But in reality different areas of the skin are sensitive to different cutaneous sensations.

Each type of receptors mediate only specific sensation. In the sense, Krause end-bulbs mediate cold sensation. Even if they are stimulated by heat stimulus they mediate only cold sensation. This is known as *paradoxical cold spot*. In the same way heat receptors even if they are stimulated by cold water mediate only heat sensation. This is known as *paradoxical heat spot*. We also come across another phenomenon called *cutaneous adaptation*. For ex :- If pressure is applied constantly for a certain length of time, the pressure sensitivity gradually decreases till nothing is felt. That is why in everyday life we do not feel the clothes on our body, ring on our finger and glasses on the bridge of the nose. Same phenomenon is found with reference to other cutaneous sensation.

As mentioned earlier all the four types of cutaneous sense receptors are not evenly and equally distributed all over the body. They are more numerous in some parts of the skin than others. However on the average there are about 25 pressure spots, 7-13 cold spots, 5-10 heat spots and 100-170 pain spots per sq. cm. of the skin. It is because of the high density of pain spots, pain is felt in all regions of the body than other sensations. Pain sensation is less in the mouth, throat and other mucus membrane areas. This being a protective mechanism, it warns the organism against the possible danger! The temperature range for cold stimulation, varies from 10°-30°C. Paradoxical cold sensation can be stimulated at 45°C with varying physiological zero. The temperature range for heat stimulus varies from 35°-70°C with varying physiological zero. A paradoxical heat sensation can be produced at 25°-30°C.

These cutaneous sensation provide us the knowledge of the world around, in their own way and help us to adjust to physical and social environments.

## ATTENTION

**Introduction :** We come in contact with our environment with our sense organs. The environment around us sends innumerable stimuli to our sense organs calling for attention. We cannot attend to all the stimuli simultaneously, but we select only one at a time and attend to it. For example, when you are

in the class room, the light in the room, the other students sitting around, the lecturer who is lecturing, are the visual stimuli acting upon your eyes, calling your attention to them. Apart from these visual stimuli, the bench on which you are sitting, the brushing of your friends sitting on either side, will be acting on pressure spots of your skin. The room temperature acting on your temperature receptors, the lecture of the lecturer and the noise outside the class which are calling your attention are in the *field of consciousness*. Of these stimuli, the one which is selected will come to the *focus of consciousness* and thus it is attended. So it is said that *attention is the process by which a certain area of the conscious field focussed on*. The selection of stimulus depends upon the nature and strength of it. Again some other stimulus from the field of consciousness will come to the focus pushing the previous one to the margin. So attention may be defined as *an active process by which selection among the stimuli takes place*. Collins and Drever have defined attention as *selective activity of consciousness* (Collins & Drever-1926).

When attention takes place, various parts of the body and the sense organ or organs concerned mobilise and make adjustments to facilitate attending. So some psychologists define attention as *a process of adjustment of the whole body with muscles and sense organs*. To aid attention the whole organism assumes a state of readiness i.e., readiness of receptors, readiness of posture, and readiness of mind (Munn-1966). All these, things can be seen with a cat waiting for a rat to come out of its hole, or the runner waiting for the signal to start.

#### Factors determining attention :

As said above the conscious selection of a stimulus from among various stimuli acting upon the sense organs, is determined by a number of objective and subjective factors. They are also known as objective and subjective determiners of attention. Certain factors are called objective because those qualities are inherent in the object which catch the attention of the individual, such as-(1) intensity, (2) size, (3) repetition, (4) movement, (5) change, (6) systematic form, (7) novelty, (8) location and nature of the stimulus. Certain

factors are called subjective because they are within the individual who attends to stimulus. Some of the subjective factors are-(1) interest (2) habit, (3) motives (4) organic state (5) attitude and prejudices.

### Objective factors

(1) **Intensity** : Our attention is attracted more by an intense stimulus, a loud sound or bright colour and sharp pain, than by a weak sound, light colour and mild pain. Here the selection depends upon the nature of the sense receptor and the amount of energy stimulated.

(2) **Size** : Large size of an object or bigger patch of colour, draws our attention more easily than small object and small patch of colour.

(3) **Repetition** : Though the stimulus is weak in intensity or strength, it gains attention if repeated several times. For ex :— a persistent tapping though weak, may catch the attention of an individual. If it is repeated beyond a certain point, due to negative adaptation it may fail to draw attention.

(4) **Movement** : Anything that moves even if it is small is able to draw our attention more than the one that is stationary.

(5) **Change** : A sudden change either in intensity or in size or sudden cessation of the continuous stimulus or sudden introduction of a stimulus catches the attention.

(6) **Systematic form** : A systematic form or rhythm attracts our attention more than the stimulus which is not systematic and non-rhythmic. Ex : A melodious music or a beautiful picture or a symmetrical building attracts the attention.

(7) **Novelty** : Anything that is unusual or strange or new, be it a sight or sound or an object, invariably draws our attention more than the usual one.

(8) **Location** : The object or the picture which is directly in front of the eyes or the picture at the centre attracts the attention more than the one in the corner.

(9) **Nature of the stimulus** : In an advertisement, it is the picture that attracts more than the words. Among the

pictures the picture of the human being attracts more. Among them, the picture of a woman attracts more. Further the rhythmic presentation attracts more than mere narration.

### Subjective factors

Though objective factors determine attention, it does not wholly depend upon the objective factors. The effectiveness of objective factors depend upon subjective factors prevailing within the individual. The subjective factors predispose the individual to respond to objective factors. The subjective factors which contribute to attention are :

(1) Interest : If a person is interested in a particular object, it attracts his attention much earlier than other objects though it is mixed up with other objects. Example : A student, who is interested in a particular book, is attracted by it earlier than other books in the library.

(2) Habits : Habits help in the selection of stimuli. All of us are habituated to react to the sound of a coin. As a result of this habit, when we are going in a busy street like market square or bus stand, if a coin drops out from the pocket of some one on the road, the sound of the coin suddenly attracts our attention, in spite of the noise all around.

(3) Motives, affection, etc : These play a great role in attracting our attention. Ex : A sleeping mother may not be disturbed even by a loud noise outside, but a faint cry of her sick baby attracts her attention even from her deep sleep.

(4) Organic state : It plays an important role in the selection of stimuli to attend to. Ex : A hungry person will be attracted more by an eatable than by any other object. Similarly the moods determine our attention. So when we are in an angry mood even a small annoyance will easily be picked up and attended to.

(5) Attitude and prejudices : When our attitude is unfavourable towards a group or a person even a small mistake committed by him will attract our attention than other things. In the same way the prejudices we foster against others make us to pay more attention to others's mistakes and weaknesses, than their virtues.

Though the factors discussed so far are classified as sub-

jective and objective factors, we cannot exactly draw a sharp line between the two, because there can never be a condition which is either purely subjective or purely objective. Both these factors depend upon our physiological and psychological make up.

The advertising agencies and other organizations concerned with mass persuasion make use of these factors to catch the attention of the consumers towards their product. The knowledge of these factors is very useful for market research or consumer research. They not only try to catch the attention of the consumers but also try to hold their attention to market their product.

### Varieties of Attending

Attending can be classified into—(1) Involuntary attending (2) Voluntary attending and (3) Habitual attending. However the classification is not a watertight compartment. [Munn 1966]

(1) *Involuntary attending* is nothing but attending something with no intention or desire to do so. We do so because we can not help it. We attend to a certain stimulus suddenly and unexpectedly at times. For example : attending to sudden loud sound or sudden flash of light, a pin-pick, an electric shock etc. We attend to these things and situations suddenly, involuntarily and automatically.

(2) *Voluntary attending* is an act of attending intentionally, deliberately and purposefully. Much of our attending is voluntary because there is always a motive, or interest or purpose behind the act of attending. Here distractions are avoided, and attention is sustained. For example : Seeing a movie, listening to a lecture or music, reading a novel etc.

(3) *Habitual attending* : There are certain types of stimuli to which we attend to not because of external compelling factors as found in involuntary attending but because of interest, drives, motives, attitudes, prejudices etc. In fact there is more or less a permanent set or readiness within us to attend such things. For ex ; Mother's readiness to hear the faint cry of her sick baby even while sleeping. A business man attending

to the phone call even though he is engaged otherwise. An adolescent boy's readiness to notice a beautiful girl passing through, though he is otherwise engaged etc..

We come across several phenomena under attention, such as- fluctuations of attention, distractions of attention, division of attention, and span of attention.

## Shifting of Attention

We hear of layman telling that he can attend to a task or read a novel for hours together without shifting his attention from the task in hand. In reality even while reading a novel his attention is not fixed on any one sentence or a word or a letter rather, he will be shifting his attention from letter to letter, from word to word, from sentence to sentence and from page to page. So, from this it is clear that shifting of attention is inevitable. The maximum length of time that an individual can attend to an object continuously is only for a few seconds. Continuous attention is possible only with plenty of shifting. This shifting of attention may be (a) fluctuations of attention or (b) distraction of attention.

### (a) Fluctuations of attention :



Reversible perspective book figure

Shifting of attention from one aspect to another aspect of the same stimulus or shifting back and forth is known as fluctuations of attention. Fluctuation is frequent, periodic, natural, and nevertheless necessary. It occurs every 5 to 6 seconds. The shortest period is 3 seconds and the longest period is 25 seconds. [Collins & Drever-1926]. This varies from individual to individual and within the individual from time to time depending upon the mental and physical states.

This can be demonstrated by a simple experiment. Take your wrist watch and hold it close to your ear for 2 minutes. You will

ear the ticking sound of your watch for some time and then gradually it disappears for sometime. Then again it appears and disappears at regular intervals. Similarly keep on observing a particular star for a few minutes, at night. First you will see the star for a few seconds and then it disappears. Again it appears and disappears at regular intervals. This phenomenon can be demonstrated in the class room by an experiment, using double perspective book figure, which appears half opened and half closed alternately. Though fluctuations occur involuntarily "will" has some control over them.

Quite a few explanations have been offered regarding fluctuations of attention. They can be classified into - (1) Peripheral theories and (2) Central theories.

According to one of the peripheral theories, ciliary muscles of the eyes are responsible for fluctuations. As fatigue sets into the ciliary muscles they contract and after a pause they relax. Due to this contraction and relaxation of the ciliary muscles, fluctuations occur periodically. This hypothesis was rejected on the ground, that fluctuations have occurred even when the accommodation muscles are atrophied by administration of homotropine.

Another explanation is that involuntary eye movements constantly stimulate the different parts of retina and thus cause fluctuations. This explains only the occurrence of fluctuations and not its regularity, and hence it is not accepted.

Another explanation is that fluctuations occur due to fatigue of the cortical cells (nerve centre) and regularity is due to cardiac and respiratory movements. This is discarded for want of proof. Finally Traube-Hering waves are caused by rhythmical contraction and relaxation of the muscles of the arteries which supply blood to brain. These waves run through a complete circle in 6 to 15 seconds. But at the time of mental strain the time interval is reduced. The fluctuations and their regularity are caused by these Traube-Hering waves is accepted as adequate explanation.

## (b) Distraction of attention :

As mentioned earlier shifting of attention from one object to another object periodically and with no reference to each other technically known as distraction of attention. Attention is said to be distracted when an irrelevant stimulus interferes with the task in hand. Example: When a person is reading an interesting novel in his room, a music band in the street, or sudden loud noise outside the room will distract his attention. Consequent upon distraction the work in hand suffers either in quality or in quantity or in both. The adverse effect of distraction does not entirely depend upon the qualities of the external stimulus like intensity, size, etc. but also on the subjective factors like conflicts, worries, anxieties etc. of the individual.

Among the distractors music is more effective than noise. Especially if music is in accordance with the taste of the person, distraction is maximum. Certain jobs like driving, research work in the laboratory, work in a factory, studies etc, will be affected very much by distraction: Distractions whether external or internal should be avoided in such places lest it is not only the productivity that becomes poor but also the accidents are likely to occur. As this is a major problem of industry, the industrial psychologists are engaged in spotting out the distraction and suggesting remedies to eradicate or atleast to minimise distracting stimuli in the workplace.

Though music is a strong distractor, it is not always so. According to some of the studies music actually increases the production. The most advantageous type of music is the one which could be set in to the rhythm of work. This type of music instead of distracting the individual, helps him to keep the tempo of activity. Apart from this, a certain type of rhythmical music in the background, keeps the worker pleasant, and cheerful and thereby helps him to reduce fatigue and boredom.

Though distraction cuts down production normally, some time the individual overcomes distraction at the cost of extra energy and effort. The production may remain the same or it increases for a short duration but in the long run it causes fatigue.

The individual under distraction shows certain behavioural changes, such as general increase in muscular tension, loud speaking, vigorous hand movement, closing the eyes, turning the head away, plugging the ears, restlessness, increase in the rate of breathing, irritability etc., If distraction is intermittent it is more effective and if it is continuous the individual is likely to develop negative adoption. Then distraction may not have any adverse effect at all.

### (c) Division of attention :

Division of attention means attending two tasks simultaneously, with equal attention and efficiency. We hear people telling that they can attend two tasks simultaneously with equal efficiency. They say that they read a novel and knit a sweater or listen to a radio programme and do knitting. As against this, studies have proved beyond doubt that one can attend only one task at a time. If any body tries to attend two tasks at a time the work suffers either in quality or in quantity or both.

If you want to know whether division of attention is possible try this experiment. Draw triangles in your right hand for a period of two minutes as fast as possible and as accurately as possible. At the end find out how many triangles are drawn correctly and note down. Then draw circles in your left hand for the same length of time without sacrificing accuracy and speed. At the end find out the number of circles drawn correctly. Finally, draw triangles in the right hand and circles in the left hand for a period of two minutes quickly but accurately. Then find out the number of triangles and circles separately. Divide the sum of triangles and circles of the third series, by the total of first and second series. The product is the *index of divisibility*. The maximum index of

divisibility is 1.0. But the obtained index of divisibility generally is less than 1.0. It clearly shows that the division of attention is not possible, and the work definitely suffers either in quality or quantity. The adverse effect is still more if both the tasks are mental. So what we call as division of attention, is not really division of attention but *quick shifting of attention* between the two tasks.

The so called division of attention is possible, when the individual is capable of shifting his attention quickly between two tasks. It also depends upon the nature of the tasks to be attended to simultaneously. It is found from studies that under the following conditions one can attend two tasks with moderate efficiency.

- (1) If one of the two activities is mental and the other is a motor activity, the latter activity due to practice becomes automatic and stereotyped, and hence needs no attention. Whereas the mental activity which needs attention can be carried out simultaneously. Example : Reading a book and knitting.
- (2) If both the activities are simple motor activities, one can carry on both the activities without paying much attention to both. Example : Drawing circles in the left hand and triangles in the right hand simultaneously.
- (3) When the two tasks are the integral parts of the same task, one can attend both. Example : tailoring, driving, etc., In each case both the hands and legs do different things simultaneously.

#### **(d) Span of attention :**

The maximum number of letters or numbers or figures that an individual can notice, or apprehends at a glance is known as *span of attention*. According to the definition of attention, one can attend to only one stimulus or only one object at a glance. So what we call as *span of attention* is only a *span of apprehension* and what we measure in the laboratory is not even *span of apprehension* but its reproduction. An individual may apprehend 6 to 7 nonsense syllables or numbers but he reproduces less than

what he has apprehended. So the real span is something more than what he reports.

An individual can apprehend quite a limited number of letters and it can be determined by an apparatus called the *techistoscope*. There are individual differences in this but usually four or five numbers or letters can be attended to at a glance.

That is why the registration number of any fast moving vehicle will not be more than four digits or figures. Additional cars are registered changing the alphabets with the numbers. Though the letters are there in addition to four figures, an individual can apprehend them also, because mind has the capacity to organise the perceptual field in to different units. So letters constitute one unit and numbers constitute another unit. Thus one can apprehend three or four groups of four to five units in each at a glance. If the letters constitute a meaningful word, one can apprehend even upto 14 letters.

The span of an individual is determined by many objective and subjective factors. Such as :

(1) Grouping and organization of the materials facilitate span of apprehension than scattering and disorganization.

(2) Pre-exposure and post-exposure field, if free from glare and other distractions, they facilitate span.

(3) If the duration of exposure period is a little more than the optimum time the span will be more and if it is less than the optimum time the span will be less

(4) Optimum and constant *interval* between the ready signal and exposure of the material facilitate span.

(5) Size of the stimulus, practice, and meaning in the materials exposed add to the span.

(6) Age, mental condition, memory images of materials observed, fatigue, familiarity and past experience also affect the span of apprehension.

# Perception

## Introduction :

Attention precedes perception, but does not always guarantee perception. However there cannot be any perception without attention. When we attend to a stimulus the sense impression will be interpreted by the respective sensory area of the cortex. *This interpretation of the sense impression is known as perception.* This perception is very essential to deal with the objective world around, more effectively and efficiently. It plays a very significant role in learning, memory, thinking, reasoning and emotions etc. Such an important concept is defined as *immediate apprehension of an object or objective reality as it is.* In the sense what we apprehend agrees with what is existing in reality. Ex :— Perceiving dog as a dog.

As the interpretation of the sense impression depends upon our past experiences, prejudices, habits, motives, emotions, context and organization of sense impressions, we are likely to err in our perception due to wrong interpretation of the sense impressions. Such errors in perception are of two types—(1) Illusion and (2) Hallucination. Illusion is a wrong interpretation of sense impression due to wrong grouping of stimuli, past experience, and mental set. So what we apprehend at times does not agree with reality. The concept of illusion is defined as *immediate apprehension of an object or objective reality not as it is but as we are.* For example : Perceiving

ope as a snake in the moonlight or perceiving a pole as a devil in the darkness. So illusion has objective reality or a physical stimulus but wrongly perceived. However it is a normal and an universal phenomenon. Whereas *hallucination* is not a normal and not an universal phenomenon. It is an abnormal and subjective phenomenon. Though *hallucination* is also an error in perception, it is not wrong perception (illusion), rather it is a false perception. We call it false perception because it has no objective basis or reality. It is nothing but mistaking a projected mental image for perception. So it is defined as *apprehending something that is not at all existing in reality*. It is a pathological condition of mind. Example: apprehending a devil or a dead ancestor or God etc.

### Factors determining Perception

Our perception is not always object oriented. That is why we perceive things not as they are but as we are. According to Gardiner Murphy, the various factors which determine our perception are : 1) Sense organs, 2) Brain function, 3) Past experience, 4) Set or attitude and, 5) Motive, 6) beliefs, 7) Emotions.

1. **Sense organs** : Perception depends upon sense impressions. The sense impressions in turn depend upon the sense organ concerned with the specific stimuli. For ex :— To perceive the colours, the shape, the size etc, the rods and cones which are distributed in the retina must be fully developed. Similarly to perceive taste, the taste buds must be matured. Thus to perceive the various stimuli the respective sense organ, the nerve cells etc, must be fully developed. So, if a particular sense organ is injured or damaged or deceased, the concerned stimuli from the environment cannot be perceived.

2. **Brain function** : Perception also depends upon the nature of the brain function, which provides various frames of reference against which perception is made. The perception of space, time, size, weight etc, are perceived because of the functions of the brain which provides the frame of reference.

3) **Past experience** : Our perception also depends upon our past experience. When we hear the horn sound of an automobile, we interpret it as a car or a bus or a truck. This is so

because, we associate the sound with the vehicle based upon our past experiences. Similarly, we perceive a friend' or an enemy or animal or a particular religious man or man of a particular nation based upon our past experience about them.

**Set or attitude :** Our perception also depends a great deal on the set or the mental attitude in a given moment. For Ex : When we are angry we perceive the mistakes of our friends more easily than when we are in happy mood. Similarly when we are in a mood of fear even a slight disturbance will be perceived as danger.

**(5) Motives :** Our perception often depends upon the motives working at the given moment. Ex :—When we are hungry we perceive certain objects as eatables even though they are not eatables in reality.

**(6) Beliefs :** What we believe to be true about the world can affect the interpretation of ambiguous sensory signals. For example ; If you believe that extra terrestrials visit earth occasionally, a round object flying high in the sky, you perceive it to be spaceship. If you do not have the above belief you will perceive that round object as a weather balloon.

**(7) Emotion :** Our emotions also influence the interpretation of sensory information. For example a small child which is afraid of darkness, perceives a robe hanging on the door as a ghost.

Thus various subjective and objective factors determine our perception to a very great extent.

### **Principles of grouping and organization**

Our perception is selective, but it does not end in itself, rather the sense impressions we get will be organised into meaningful units. Otherwise our sense impressions will have no meaning. So the organization and unit formation take place according to certain principles, such as : (1) Proximity or nearness, (2) Similarity, (3) Continuity, (4) Closure, (5) Inclusiveness, (6) Familiarity or past experience, (7) Figure and ground relationship.

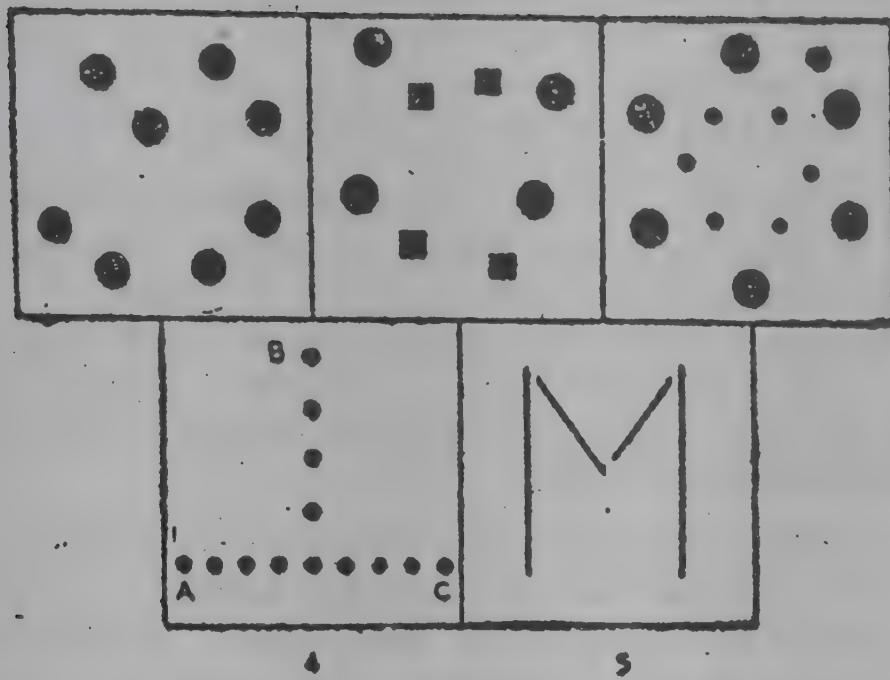


Figure 17 : Principles—(1) proximity, (2) similarity;

(3) inclusiveness, (4) continuity, (5) closure (Boaz 1968)

(1) *Proximity or nearness* : Objects or figures or dots which are close together form a unit or a pattern. On the other hand the same figures or dots if they are widely separated will have no facility of forming a unit or pattern even if they are similar in shape or form. Example : Though all the dots in the figure 17 are similar, they do not form a unit, rather they look like pairs of dots due to proximity.

(2) *Similarity or likeness* : Objects or figures which are similar in shape and form, though mixed up with other things, will have a tendency of coming together to form a unit or a pattern. Example : All dots in the figure form a unit and all the squares form another unit though they are all mixed up in a figure. Thus similarity may be in the form or colour or size, etc., which have an advantage over proximity.

(3) *Inclusiveness* : Sometimes due to past experience of training, objects whether similar or not, close together or not, if they are in a place, they will have a tendency to form a unit and do not appear separate. Example : In figure 3 dots both bigger and smaller irrespective of their size will form a meaningful pattern.

(4) *Continuity* : Continuous line of dots irrespective of shape, or size or colour will have a tendency to form a unit.

**Example :** In figure (4) dots which are continuous on a horizontal plane, form horizontal line and dots on vertical plane form vertical line. Though all these dots are similar and equal some form horizontal line and some form vertical line. They together form a horizontal-vertical illusion figure.

**(5) Closure :** There is always a tendency for incomplete figure or nearly complete figure, to appear complete. Of course forming complete figure from out of incomplete ones depends upon our past experience. Example : In figure-5 four unconnected lines which are distributed in a particular way will be perceived as letter 'M'. Here small gaps are overlooked while perceiving the figure.

**(7) Familiarity or past experience :** From miscellaneous mass of dots or lines a familiar pattern or a figure stands out more easily as an organised unit than others. No doubt this depends upon our past experience. This is a strong factor.

**8. Figure and ground relationship :** Some decades ago William James a German psychologist said *perception of an infant is big booming buzzing confusion*. By this he meant that the young infant cannot perceive anything clearly and in its perceptual field nothing takes any definite or clear shape. The Gestalt psychologists have bitterly criticised this and said that even in the simplest form of the perceptual process the factor of figure and ground relationship operates. According to them even in the early stage the figure of the mother who comes in the perceptual field will stand out as one harmonious unit as against the other things of the environments, such as the room, the walls, and the furniture. The perception of the mother may be vague and devoid of meaning but still it will be perceived as a unit different from the background against which she is seen. Thus any perception is made against some background. The formation of the figure mostly depends upon the more advantageous shape or contour or colour of some particular part of the field of awareness. So in every perception there is figure and ground relationship. The figure which emerges from the background may become a background for some other figure. Ex : Face which stands out as a figure in the background of body becomes background to the nose or eyes etc.

## Characteristics of perception :

As perception is the end product of attending sensations all the characteristics of attention are also found in perception. Some of them are :

1. Perception shifts : As we attend to a part of the stimulus we perceive it. When attention passes on to another part we perceive that also. Thus perception shifts along with attention. This can be demonstrated by double perspective book figure or the figure with two faces and butterfly.

2. Perception is a grouping and combining response : We generally put a number of stimuli together and make a joint response to it. Example : When we perceive the face of a friend a number of stimuli from the face such as eyes, ears, nose, come to us, We put them all together and understand them as a unit.

3. Just as attention, perception is selective : Depending upon the subjective and objective factors, discussed in the previous chapter a stimulus from the field of consciousness will be selected, attended, and perceived. Thus we perceive the thing we select.

(4) Figure has an advantage over background in perception. We attend to things which have a better shape than others. Even if there are gaps in the figure they will be filled up mentally and perceived as a full figure.

(5) We perceive objects in terms of reduced cues or redintegration process. A cue is a sign or symbol. As we become more and more familiar with an object, we perceive it in terms of reduced cues. That is a part of the total stimulus is sufficient to perceive the object in total. For example : The colour of the coat father wears is sufficient to perceive him in totality. We need not see all the details of him. To recognise a newly introduced friend we stare at him for several minutes and take many details into account in the beginning. As we become familiar with him we recognise him from his voice, the sound of his foot steps, his cap etc.

(6) Perception involves context : Everything that we perceive will have a context. Without context we cannot understand anything. With reference to the context an object

looks small or big, bright or dull etc. For example : an object at a distance appears small and same object nearby appears big. An individual 5 feet tall appears taller amidst those who are 4 feet tall. In the same way we do not understand anything for sometime when we enter the cinema theatre in the middle of the show.

(7) Perception involves time and space : Anything that we perceive, not only has a place but also has time. Example : we perceive the time of the event and place of the event.

(8) Perception has movement : Perception not only has place but also movement. That is why we perceive the movement of an object, Example : Moving car, train etc.

(9) Perceptual constancy is another characteristic of perception. The size, shape, colour and brightness of an object appear to be the same within certain limits or within certain distance. Only when it is moved beyond certain distance the size or shape etc., appears different. Example : Hold a rupee coin at a distance of one foot away from your eyes. Then gradually move it away from your eyes. Up to a certain distance, the size of the coin appears to be the same. Only beyond certain distance it appears small.

### Perceptual Constancies :

The ability to perceive objects as stable or unchanging inspite of the fact that sensory patterns they produce are constantly shifting is known as "Perceptual constancy". In other words the accurate perception of objects as stable or unchanged despite changes in the sensory patterns they produce. The best constancies are visual ones. Some times lighting conditions, angle of seeing the objects, and distances of objects, etc change as we move around. Yet we see the objects with no changes i. e. they appear to be constant in shape, size, colour, brightness and location.

1. Size Constancy : We continue to see an object with constant size, inspite of the fact that the retinal images (becomes smaller or bigger with the increase or decrease in the distance at which we see the same object. For example hold a rupee coin at a distance of one foot away from your eyes,

and gradually increase the distance of the coin. Correspondingly the retinal image reduces in size, but the coin appears to be the same in size upto a particular distance, which is technically known as "optimal distance". This perceptual constancy of size is due to familiarity of the object and apparent distance of an object. According to this author, (1) This phenomenon is due to the fact, that perceptible differences between the retinal images caused by the distances with in the limit may be beyond comprehension. (2) Context is also an important factor in the judgement of size.

**2. Shape Contancy :** Perceiving the shape of an object constant inspite of the fact that the shape of the retinal image changes with the change in the angle we see it is known as "shape constancy". For example-observe a rupee coin from above, and it appears round or circular. Slowly move your head to its side (Right or Left) slowly the retinal image becomes elliptical but still we perceive it to be circular within certain angle of perception. This is again due to familiarity and failure to perceive the perceptual difference of the retinal images.

**3. Location Constancy :** Perceiving the stationary objects as remaining in the same place even though the retinal image moves constantly as we move our eyes, head and body is known as "Location constancy". For example when you drive along the highway, electric poles, telephone poles' and trees fly by-on our retina. As we know that our body is moving and not the poles and trees make us to perceive them as staying in the same place.

**4. Brightness Constancy :** Perceiving the brightness of an object more or less constant even though the amount of light they reflect changes as the overall level of illumination changes. For example : snow remains white even on a cloudy day as it is seen on a sunny day.

**5. Colour Constancy :** Perceiving the colour of an object as constant despite the fact that the wavelength of light reaching our eyes may change some what. For example : the colour we perceive either in out door light or indoor light remains the same.

## Illusion and Hallucination

Our perception is not always accurate. Due to reasons internal or external, known or unknown, errors in perception do occur. Such errors in perception can be classified into two categories-(1) illusion (2) Hallucination.

### Illusion :

Illusion is wrong perception or mistaken perception. The perceptual process involves interpretation of the sensory experience in the light of our past experience, present attitude, organic needs etc. Consequently if the interpretation is done wrongly the stimulus perceived will be wrong. Such a phenomenon is known as *Illusion*. It is defined as *immediate apprehension of an object or objective reality as we are and not as it is*. So in illusion, apprehension does not agree with the reality. Illusions are also interpreted as erroneous or misleading perception in reality. The classical example is our perception of a rope as a snake in the moonlight. The stimulus is like the one coming from a snake and it is quite real and objective. Because of the similarity between the two, we perceive a rope as a snake in the moonlight as guided by our past experience and fear. In illusion there is always an objective reality but it is mistaken. Thus illusion is a normal and universal phenomenon, unlike *hallucination* which is abnormal and not universal. Further there is no objective basis for hallucination, but the mental image is projected and mistaken for perception. Example : Perception of Devil or God.

In order to understand how illusions are caused and what are the reasons for it, psychologists have studied illusion by making use of a number of geometrical optical figures which cause illusion. Illusions are valuable to psychologists because they are systematic errors which provide hints about perceptual strategies of mind. Just as size, shape, location, brightness and colour constancies, illusions are caused by these factors. The most important and frequently used popular geometrical figures are *Muller-Lyer illusion* and *Horizontal-Vertical illusion*.

**Muller-Lyer illusion :** In the Muller-Lyer illusion there are two straight lines of equal length. One is bounded by a

pair of arrow heads at both ends and another line is bounded by feather heads at both ends. Though both the lines



Figure 18 : Muller-Lyer illusion.

are equal in length, the arrow heads line appears shorter than the feather heads line. This is nothing but an optical illusion. This illusion is due to perception of the lines in the context of the arrow heads and feather heads attached to the lines. Generally there is a tendency to under-estimate the arrow heads line and to over-estimate the feather heads line. The total illusion is the product of two illusions of the opposite directions which are of equal force. That is the line with the arrow heads appearing shorter than what it is and the line with feather heads

appearing longer than what it is. In short the illusion is due to unanalysed total impression of the two lines with their appendages.

This illusion is due to many factors like, accommodation expectancy, thickness of the arrow heads and feather heads, thickness of the lines, colours, angles of the obliques, different position of the two lines, age and experience of the subject etc. (P.Nataraj, 1970)

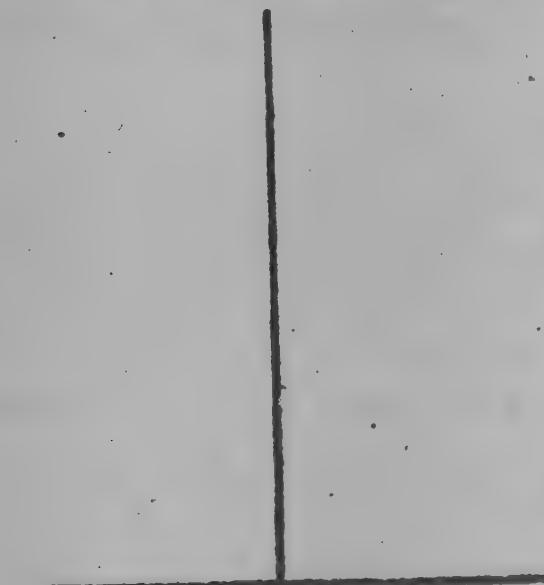


Fig. 18 : Horizontal-Vertical illusion

**Horizontal vertical illusion :** In the horizontal-vertical illusion figure, the vertical line is drawn from the mid point of the horizontal line in the right angle position. Though the lines are of equal length the vertical line appears longer than the horizontal line by virtue of its position. This is because the movement of the eyes along

vertical line is more strenuous than the movement of the eyes on the horizontal line. Naturally the vertical line looks longer than what it is and the horizontal line looks shorter than what it is. Another reason is that, the horizontal line is cut at the intersection which makes it look shorter than its counter-part vertical line. This is known as *horizontal-vertical illusion*.

According to the studies made by the author (Nataraj, 1970) several factors contribute to this illusion, i. e. : (1) Colour of the two lines. If both the lines are of the same colour, illusion is less and they if are of two different colours (complimentary colours) illusion is more. (2) If the vertical line is in right angle position illusion is more and it becomes less as the magnitude of the angle is increased or decreased. (3) The magnitude of illusion is directly proportional to the length of the two lines. (4) If the horizontal line is thicker than the vertical line, illusion is more. On the other hand if the vertical line is thicker than the horizontal line, illusion is less. (5) If there is gap at the intersection, illusion is less. If there is no gap the illusion is more. (6) The rate of increasing or decreasing the vertical line to make it appear equal to the horizontal line makes the magnitude of illusion to vary. Apart from these objective factors, the subjective factors like—(a) Age, (b) Practice, (c) Social facilitation also affect the magnitude of illusion. In the sense illusion increases up to 12th year of age and then remains constant, with practice it decreases upto a level. With social facilitation the magnitude of illusion increases. (P. Nataraj 1970).

### Illusion of movement-Phi-phenomenon

Perceiving movement is one of the characteristics of perception. It is an innate nature of mammalian vision. Though perceiving movement is natural, perceiving apparent movement of an object is known as illusion of movement or *phi-phenomenon*. What we see on the screen in a cinema theatre is not the real movement but a series of still pictures projected on the screen at a particular speed i. e., 20 to 25 pictures per second. The neon lights advertisement is also based on this principle. The perception of apparent movement is due to *primitive organisation of perception*.

The illusion of movement can be demonstrated by *phi-phenomenon apparatus* in the laboratory. This apparatus has two lights in a line. As the two lights are moveable, the distance between them can be adjusted as required. This apparatus has a control to vary the brightness of lights. In front of lights there is a milky glass screen. By connecting this apparatus with a metronome the rate of *on and off* of the two lights can be regulated. By switching on the light the two lights can be made to go *on and off* alternately at a particular speed. But we experience it as if only one light is hopping back and forth. This is known as illusion of movement. In the same way we experience *auditory illusion* from different directions at the cinema theatre. Thus we experience different forms of illusions referring to different sense organs.

Several factors contribute to this phenomenon (Postman and Egan, 1964). Such as.

(a) *The pause between the two stimuli* : If the pause is less than 30m. per sec, we perceive both the lights simultaneously. On the other hand if the pause is more than 400m. secs we perceive the succession of stimuli without apparent movement.

(b) *The distance between the two lights* : As the distance between the two lights is increased, the value of the pause must also be increased for optimal movement.

(c) *Brightness of the lights* : If brightness is decreased keeping distance constant, the pause for optimal movement increases.

(d) *As the distance between the subject (S) and the apparatus increases holding other things constant, apparent movement increases within certain limits.*

(e) Individuals with *analytic attitude* do not perceive apparent movement.

### Causes of illusions

Optical illusions are caused by many factors. Some causes are more predominant in some forms of illusions. In some other forms of illusion some other causes are predominant. Some illusion will have more than one cause. However some of the causes of illusion are :

(1) *Similarity* : If two objects are similar in appearance illusion occur more easily than others. Example : It is natural to mistake a curled rope for a snake due to similarity.

(2) *Expectancy* : if we are waiting for a friend, every individual at a distance will be mistaken for the friend. While searching for the coin lost every glittering object is mistaken for the coin which we are searching.

(3) *Physical causes* : The mirror-illusion and the echo illusion are good examples for this. The former is due to reflection of light and the latter is due to echo of sound. The mirrored objects seems to be behind the mirror because the light reaches our eyes from that direction. In the echo illusion the echo seems to come from somebody across the lake because the sound actually reaches our ears from that direction.

(4) *Unanalysed total impression* : This is clear from Muller Lyer-illusion. Here though we are supposed to perceive and estimate the actual length of the lines excluding the appendages we will be compelled to perceive the total figure and thus over-estimate or under-estimate the lines. Thus this unanalysed total impression causes illusion.

(5) *Subjective factor* : Such as habit and familiarity cause illusion. Example : Cross two fingers and touch a marble or hold a pencil with the crossed part of both the fingers, and you will feel two marbles or two pencils. Another example is proof reader's illusion.

### **Hallucination :**

Another form of error in perception is hallucination. Hallucination is nothing but mistaking the mental image for an object or a person. Here we perceive a figure or an object purely because of subjective condition, though there is no objective stimulus. Such an error in perception has no sensory stimulus. Though illusion is also error in perception, it is wrong perception. whereas hallucination is false perception. Thus these two differ in certain respects— (a) Illusion has an objective basis whereas hallucination has no objective basis which is purely subjective. (b) Hallucination involves images whereas illusion involves no images, (c) Illusion is normal and an universal

phenomenon, whereas hallucination is abnormal and subjective phenomenon. It indicates the pathological condition of the mind or a symptom of psychoses. For Ex:—Perceiving a ghost or God when there is no stimulus actually. Hallucinations take place because of inner fears and conflicts. Sometimes an intense wish or hope may also produce hallucination. For Ex:—Mirage. The hallucinations are also caused by drug and alcohol addiction. Hallucinations are generally either visual or auditory in nature than of other forms.

## CHAPTER V

# Learning

### Introduction :

Many lower animals are endowed with tropism, reflexes and instincts. These three hereditary endowments are sufficient to meet the demands of adequate adjustment to the world around. They are also sufficient to meet the basic needs necessary to survive. So to say, that many animals are practically self sufficient. They escape from danger, satisfy their hunger, thirst, sex and seek shelter without any learning or training. All these behaviour emerge spontaneously as and when the concerned structures are matured. Even the neonate without learning, sucks, breathes, swallows, excretes, and cries when it is hungry. The sexual and gregarious behaviour emerge with maturation of the concerned structures.

As we go higher in the scale of evolution and as the brain becomes increasingly complex, the hereditary endowments which help to meet the basic needs or the unlearned behaviour give way gradually to learned behaviour. This is so because the tropism reflexes, and instincts become inadequate to meet the demands of the complex organism in the complex world. As we reach the human level, practically everything beyond basic physiological processes and reflexes are learnt. The human nature is thus to a large extent acquired.

If man is deprived of what he has learnt, he will revert to the level of an infant. If he is deprived of social heritage which he has acquired, he would be no better than a savage. That is why learning is considered to be the most important psychological process which forms the basis for almost everything that makes him psychologically different from other animals and other human beings. In short man becomes a human being by learning to give up impulsive, aggressive animal behaviour and by acquiring the essentials of socio-cultural contents of society to which he belongs.

We learn many things to fit into the world of reality and morality such as, habits, skill, social activities, religious beliefs, customs, traditions, rituals, moral values and so on. What we learn can be classified into a few categories : (1) we learn *not to react to irrelevant stimuli*. For ex :— Certain sights and sounds which disturb us will be ignored or tolerated or get accustomed to. (2) We learn *relatively simple responses to the immediately relevant aspects of our environment*. Ex :— The neonate learns to find the mother's breast or the nipple of the bottle and sucks it when it is hungry. (3) We learn *motor skills* like reaching, grasping standing without support, put on our clothes etc. Simultaneously we learn *verbal skills like* understanding the words and symbols used by others and using the words to convey our thoughts, feelings, experiences etc. (4) We learn *solving the simple problems* in the beginning and more *complex ones* later. (5) We acquire *information* about ourselves and the world around. This facilitates the acquisition of skills and solution of the problems confronting us. Thus we find a gradual transition from simple form of learning to the most complex ones.

Learning is not peculiar to man alone. It is found in simple form, even at the lower level of animal. But it increases gradually from phylum to phylum in the course of evolution and with the increase in the complexity of nervous system. This becomes clear from the studies made on animals at various levels by eminent psychologists like Thorndike, Morgan, Watson, Lashley, Pavlov, Skinner, Kohler and others.

## What is learning ?

(a) Learning is a process by which the individual acquires various habits, knowledge and attitudes that are necessary to meet the demands of life in general. Thus learning adds new knowledge, and new ideas and thereby helps us to deal with the environment more effectively and efficiently. (b) It will not help us simply to deal with the environment in old ways, rather it guides us to deal with our problems in new ways also. (c) Learning being purposive in nature, it directs the behaviour towards the end results, which satisfy us by releasing tension created by a particular need.

In short, it is said :

(1) Learning modifies and changes one's behaviour with reference to achieving a particular goal.

(2) It establishes new relationship between a stimulus and a response. This involves new neural connections.

(3) It is a process of developing new method or technique to deal with one's problem (Boaz 1968)

Considering all these points, learning may be defined as a *Process of effecting a change in behaviour which generally produces an improvement in our relations with our environment. Munn(1966) defines it as the process of being modified more or less permanently, by what happens in the world around us by what we do, or by what we observe.*

### Differences between man and animal in learning

In order to meet the vital needs of everyday living, animals are provided with hereditary endowments called instincts. The Physical structure of the organism is so designed, that it facilitates the operation of instincts, such as food seeking, mating, combat, etc. To satisfy these basic needs animals need not learn, but it is not so in case of man. Man's activities do not confine to only basic needs and their satisfaction, but has to learn many more activities to adjust to the complex environment. He is provided with more intelligence, memory, and some special capacities which are not found in animals. With the abilities he is endowed with, he has developed language which helps him to understand others and to convey his thoughts, feelings and actions. In short all these help him

to adjust to his physical and social environment effectively and efficiently.

(1) The difference between man and animal in learning is due to *superior intelligence* found in man. By making use of his intelligence he not only learns faster but also uses less effort.

(2) Man's *memory* is better than that of animals. It helps him to save time and energy in learning the material given.

(3) Man has the ability for *abstract thinking* which is lacking in the lower animals. This abstract thinking helps him to plan out learning before making any effort to learn. He plans out how much he has to learn at a time, how he has to learn, what he has to learn, what are the right movements and what are wrong movements etc. Naturally this planned mode of learning not only helps him to minimise errors but also to save time and energy. Consequently learning will be more efficient and effective. As this ability is lacking in the lower animals, mostly they resort to trial and error method which consumes more time and energy.

(4) Man has *verbal facility* which is lacking in animal. This helps him to read and understand the instructions or the directions given, either in the books or given by others. This knowledge helps him to learn the given material faster and better than the animals.

(5) Man's ability to learn by *imitation* is far superior to that of lower animals. No doubt monkeys and chimpanzees have the ability to imitate but it is not so much as it is in man. Naturally this helps man to learn better than the lower animals.

Thus various facilities that man has, help him to learn the given material more efficiently than the lower animals [Woodworth & Marquis 1955]

### Learning in animals

In order to understand the various aspects of learning viz, the nature of learning, factors which facilitate learning, kinds of learning, methods of learning and neurological changes under learning, psychologists have made innumerable studies. They have used : white rats, guinea pigs, cats, dogs and chimpanzees as their subjects for their studies. The apparatus

used to study animal's learning are ; mazes, puzzle box, fence  
gages etc.

Some of the important mazes they have used to study man's learning are : Hampton Court garden maze, slot-maze step-maze, finger-maze, etc. The path in the maze is neither simple nor direct but mixed up with a number of blind alleys. Hence it has to wander in the maze to find the correct path from the entrance to the goal. Only when it reaches the goal the hungry animal gets food. Learning to trace the correct path is not an easy task to the animal because it is mixed up with the blind alleys or dead ends. Avoiding the blind alleys and running through the correct path from the entrance to the goal is the criterion of learning. To attain this criterion the animal in the beginning enters into the blind alleys a number of times and finally by chance it reaches the goal. Entering into the blind alley is an error and it does not lead to the goal. Such errors reduce gradually as the trials progress. Finally it learns to run through the correct path without entering into the blind alleys which is the criterion of learning. This type of learning is known as *Trial and Error* learning.

In order to study maze learning in man psychologists have used finger maze, step maze, mirror tracing board etc. As the path is not known to the man he commits a number of errors in the beginning and these errors gradually reduce as the trials progress. In spite of the fact that man is more intelligent than the animals, he also shows trial and error type of learning in the absence of the knowledge of the correct path.

### Trial and Error Learning

In order to study the kind of learning that the animal shows or to study how animals learn, a good number of experiments are conducted on animals using different apparatus. In this connection it is appropriate to recall the study of E. L. Thorndike a pioneer in the field of animal learning. For his study on the animal learning, he constructed a cage called *problem box or the puzzle box*. He kept a hungry cat inside the cage and a piece of fish outside the cage at a little distance. The cat was kept hungry to motivate it for action.

The box was built in such a way that the door could be opened only by pressing the lever, inside the box. Learning to press the lever to open the door is the criterion of animal's learning.

Thorndike (1899) gives a graphic account of behaviour of the cat in the cage. According to his report the cat became restless and made all kinds of attempts to get out of the cage like clawing, biting the bars, shaking the moveable parts, pushing the snout between bars, stretching the leg to reach the fish and so on. All these random activities of the cat indicate that learning is purely by trial and error method. While making these random movements accidentally the cat operated the lever and opened the door. Then it went out and ate the food. Again the cat was put into the box, closed the door and kept a bit of fish in the same place. In the second trial also the cat was restless and made random movements in the beginning and finally operated the lever, opened the door and ate the food. The same procedure was followed until the cat was able to open the door straight away without making any random movements. As trials advanced the unnecessary and irrelevant movements were gradually reduced. Finally, the cat learnt to operate the lever straight away.

He also conducted similar experiments on dogs and monkeys. From the results he obtained he has mentioned the following salient features of animal learning—(1) from trial to trial the useless movements gradually reduce. (2) the random activities become more specific. (3) Finally, the animal learns the trick. These are the characteristic features of *blind learning or rote learning*. He called this *trial and error method* of learning. Here the animal actually learns to select certain movements in terms of their consequences. To explain this process of learning he has suggested three laws of learning.

### Thorndike's Laws of Learning

The three laws that Thorndike suggested are : (1) law of effect, (2) law of frequency, (3) law of recency.

(1) *Law of effect* : According to the law of effect, any activity that gives satisfaction of success, has tendency to be established and gets fixed up. On the other hand any activity

that does not lead to the desired goal and causes the feeling of disappointment and dissatisfaction has a tendency to be discarded or dropped out. Thus the *Stamping in* and *Stamping out* of any activity is determined by the effect it produces. So a satisfying state caused by any movement or an activity will be retained or maintained. On the other hand an annoying state caused by an activity is likely to be dropped out.

According to Thorndike the speed of learning or the speed of establishing the connection between the particular activity and the particular goal depends upon the satisfaction value of the rewards. The efficiency of learning depends upon the size of the reward and the length of time that lapses between the correct movement and the reward obtained. If the reward is very small or the interval is long, learning becomes slow. On the other hand if the reward is big or the interval is short learning will be quicker. So every successful movement that the cat has made in each successive trial was established and fixed up. The unsuccessful movements that the cat has made were discarded. Thus the cat has learnt to press the lever and to open the door of the cage.

(2) *Law of frequency* : According to this law any activity repeated a certain number of times has a tendency to be established permanently. Thus the repeated activity becomes stronger and easier to repeat it. On the other hand any activity that is not repeated is likely to be atrophied or it disappears for want of repetition. Though wrong movements are also repeated, they will be dropped out gradually for want of reinforcement or due to dissatisfaction attached to them.

(3) *Law of Recency* : According to this law, any act or activity which is done recently has an advantage of being repeated once again because of fresh experience. So the right movements done recently accompanied by reinforcement and repetition help trial and error method. Thus these three laws or principles govern the trial and error learning.

The laws of recency and frequency are together called the law of exercise. The law of effect is known as the law of reinforcement.

Lloyd Morgan the founder of animal psychology has studied learning in animal by experimenting on a dog. The dog which was selected for this experiment was first placed in a small front yard enclosed by a picket fence. The dog showed eagerness to go out of the yard into the street. So it pushed its snout between the pickets one after the other without knowing where the solution was lying. As the gate latch was located in one of the space between the pickets the dog accidentally removed the latch by its snout, the gate opened and the dog went out of the yard. When the experiment was repeated on subsequent days the random movements shown by the dog gradually reduced. The dog learned to go directly to the latch and removed it with its snout.

Here the dog's behaviour seem to be of less reasoning, less deliberate and more impulsive. However it showed variation in its behaviour to reach the goal. This variation is due to trial and error learning. The movements which have not led to the solution were dropped out and the correct movements were strengthened.

Essentials of trial and error learning are : (1) A set to reach a certain goal, (2) there is no clear and definite way to reach the goal, (3) exploration of the situation, finding the possible leads and trying them, (4) finding a good lead and reaching the goal.

An analysis of the behaviour of the dog in the above experiment reveals, the dog first learnt where to work, secondly it learnt where exactly to work, (space between the pickets), this refers to place learning. Finally it learnt how to manipulate the latch. This is called tool learning or thing learning. Here the animal learns to deal with places and this is not due to the higher mental process but learning to respond to certain sensory stimuli by making muscular movements. Whereas higher animals learn place and things, by knowledge and not directly by the stimuli received. Further a number of studies are made to know what exactly the animal learns and how it learns.

**Maze learning : One of the most common experiments in Learning**

animal learning is maze learning by white rats. Various types of mazes with different degrees of complexity are developed. Generally the maze has wrong turns leading to blind alleys. The correct path leads to the goal where the rat finds food. The plan of the experiment is to see the number of trials that the rat takes to learn the maze successfully, i.e., to run through the correct path without entering into blind alleys in the shortest possible time. Entering into the blind alleys is taken as an error. In order to motivate properly, the rat is generally kept hungry for 24 hours prior to the experiment. Otherwise it may sleep in the maze without trying to run through the maze.

When the rat is placed at the entrance of the maze it cannot see its way to the food. Naturally the rat becomes active and begins to explore the maze in a disorganized way. It enters into all the leads, leading to blind alleys. Finally it reaches the food. After allowing it to eat a small bit of food kept there, it is placed again at the entrance. Thus several trials will be given per day. As the trials advance the rat reduces entering into the blind alleys and even if it enters, it does not go deep into the blind alley rather it turns back. Finally after a number of trials spreading over a few days rat learns to avoid entering into the blind alleys and runs directly and quickly through the correct path to reach the food. For each trial the number of errors and time taken are noted.

In order to explain what exactly the rat learns psychologists have suggested a few theories mentioned below.

(1) Watson the founder of behaviourism has stated that the animal learns only a fixed series of movements. This theory is known as chain reflex theory. According to this theory the useless movements will be discarded by the animal and a fixed, regular chain of movements become conditioned and established. This theory was criticised and discarded on the following grounds.

After the rat has learnt to run through the maze successfully the maze was filled with water and the experiment was repeated. If the chain reflex theory is correct, the rat has to relearn the maze because it has to swim through the path to reach the goal. Here the reflexes and the motor movements required are different from those required for running through

the maze when it is dry. But to the surprise of the investigator the rat swam through the path directly and quickly to the goal inspite of the differences in the situation. From this it is clear that the chain reflex theory is wrong because the rat does not learn a series of fixed movements rather it *learns the path*.

Lashley repeated the experiment, by operating the limbs of the rat which had learnt to run through the path successfully. Thus the rat was disabled to run through the path in normal way. Still it stumbled and rolled through the correct path and reached the goal directly. This experiment proves that the chain reflex theory does not hold good to explain all maze learning by rats. Similar experiments made in this line, have shown that kinaesthesia as implied in the chain reflex theory cannot be the sole factor in establishing the learning process.

(2) Then *fixed path* theory was offered to explain rats learning the maze. According to this theory the rat learns a fixed path as suggested by modified experiments. They have used mazes with two or three alternative correct paths leading to the goal. The rats have chosen one correct path at one time and another path another time and so on. However they showed a tendency to prefer the shortest and the easiest one. So this theory was also discarded.

(3) Generally accepted theory is *place learning theory*. According to this theory, the rat not only learns, where to work, and what exactly to work, but also learnt the whole situation. i. e., perceives the field of objects with their mutual relationships. This theory is better known as *situation learning theory*. From this we understand, that learning is nothing but perceiving of a course of action to a goal in a particular situation. The pattern of movements learned is only a consequence of perception of the pattern of spatial relationships, and inner tensions felt towards reaching the goal.

### Maze learning in human beings

In order to study learning process in human beings psychologists have used, Hampton court garden maze, finger tracing maze, step maze, mirror tracing board etc. Generally 'S' is blind folded so that he cannot see the entire structure of the maze while learning to trace the path. In some cases the 'S'

has to trace the path with finger or with stylus. The results reveal, that learning process with human 'S' takes more or less the same course as with rats. Man also learns by trial and error method. Errors and time gradually reduce with trials. The advantages the man has; is the capacity to verbalise and to plan out the movements before actually executing trial and errors method.

One of the commonest laboratory experiment is tracing the star pattern by a chalk piece or stylus in the *mirror tracing board*. The 'S' has to trace the star pattern either with a chalk piece or stylus, without touching the edges. While tracing the pattern the 'S' is not supposed to look at the star pattern directly but has to see the pattern through the mirror where the whole thing is *reverse*. So, it requires some learning before one can correctly trace the pattern. This experiment reveals, trial and error learning, insightful learning, conditioning, forming abstract relationships etc. The same apparatus is also used to study transfer of training and effect of punishment on learning.

### Insightful learning

Most of the experiments of Thorndike are concerned with learning motor skills leading towards a particular goal. From the results he had obtained, he arrived at the conclusion that all learning take place only by trial and error method. This was because that the perceptual field available was limited and it did not include the solution. In other words the solution was not in the perceptual field and hence learning was of trial and error type.

Wolfgang Kohler one of the founders of Gestalt school has emphasised the factor of perception in learning. He pointed out the problems set by Thorndike are too difficult for the animals. The latch or the press button was not at all within the perceptual field of the cat. Naturally the cat resorted to trial and error method. Even men under similar situation uses trial and error method. Suppose a person is locked up in a room, where the electric switch concerned with opening the door is concealed and he is not told about the switch, he is sure to adopt only trial and error method. He tries all the possibilities

one by one at random. In the same way Thorndike's problem was too difficult and the solution was not within the perceptual field of the animal. Hence it had resorted to trial and error method.

Kohler in one of his experiments on learning, put the chimpanzee by name Sultan, inside a cage and kept a banana outside the cage at a little distance. He placed two sticks (one longer and another shorter) inside the cage. The chimpanzee could get the banana only by using the longer stick. Accordingly, the chimpanzee used the longer stick and got the banana. It was able to get the banana because it grasped the whole situation. It is a sign of *insight*.

In another experiment, he kept the same chimpanzee inside the cage along with two sticks (one longer and another shorter) One had a sharp edge and another had a hollow, so that thrusting one into the other, the stick could be made longer. The banana was kept at such a distance that it could be reached only by joining the two sticks together and not by using any one stick. When the experiment started the chimpanzee became active and tried various means of reaching the banana.

The disgusted chimpanzee gave up its attempt to reach the banana and started playing with the sticks sitting in a corner of the cage. While so playing accidentally sharp edged stick fell into the hollow of the other stick but not properly. This gave the animal a *brain wave or bright idea*. The animal straight away joined the two sticks firmly stretched it towards the banana reached it and got it.

Kohler emphasises the suddenness with which the right solution appeared. It was not a gradual learning by trial and error method. The sudden idea leading to the solution is called *insight*. So he says that animal learns not only by trial and error method but also by insight. What really happened in the case of chimpanzee was not a gradual development of a motor skill but a new perception of the situation. What the animal learnt was not a particular skill in the manipulation of the sticks but a new way of perceiving the situation. The

possibility of combining the two sticks and possibility of reaching the banana, were all perceived as organised factors of the perceptual field. The animal learned to see the situation as a whole. The solution was possible because all the factors concerned with the solution were within the perceptual field of the animal. The suddenness and new way of looking at the problem and solving it is called *insight*. In other words, understanding the interrelatedness of various factors concerned with the solution is known as *insight*. This is based on previous experience. It also involves a new way of perceiving logically the cause and effect relationships. Here we do not respond to stimuli but we solve a problem. In other words this kind of learning occurs in problem solving. It appears to involve the understanding of how the elements of a situation are related and can be organised.

In order to confirm his findings he conducted experiments on other animals and children. All these experiments have shown that at some stage there is a new organization of the perceptual field resulting in getting the solution all of a sudden. This he called *insight*. It does not depend upon the past experiences.

### **Learning by imitation or observational Learning**

Apart from learning by trial and error method and by *insight*, animals and human beings also learn by observing others doing it. In observational learning the learner observes a model and makes certain responses and experience the consequences. Sometimes "mimics or imitates the response, shortly after observing them. Although higher animals may learn a great deal by observing and attempting to copy the performances of others, they must first *learn to imitate*. If imitation is to be possible, the activity to be imitated must be within the limits of the imitator's ability. Otherwise imitation becomes impossible.

Learning to imitate is illustrated by an experiment conducted by Miller and Dollard on 42 first grade children. Two boxes were kept on two chairs in a room. One child (the leader) was told, which of the two boxes must be opened to

secure a piece of candy. That box contained two pieces of candy and the child was instructed to take only one piece and leave the other behind. The second child (imitator) was rewarded with the second piece of candy if he opened the same box as the leader. He was not rewarded, if he went to the other box. Both the children first stood at a short distance away from the two chairs on which the boxes were kept. As the experiment continued the position of the candy was changed from box to box in random order: (1) It was found that only 20% of the children learned by imitation to go to the correct box in the first trial (2) On the average it took 3 trials for the imitator to copy the performance of the first child. Later on in the same experiment four boxes were used instead of two. They were arranged at four corners of an imaginary square. (1) Here, only 75% of the children imitated correctly at the first trial itself. (2) This demonstrates the transfer of principles involved in the first learning situation to the second one. So, due to transfer of training 75% have succeeded in imitating at the very first trial alone.

From this we understand that children can be taught to imitate certain responses when the basic principles of learning and motivation are followed. By this technique children acquire certain attitudes and responses during the course of socialization. Some time the learning remains latent and start operating at appropriate time or age. The factor of maturation plays an important role in learning to imitate. For ex:- an immatured child cannot learn to walk by imitation. Similarly by mere observation a boy cannot repair a watch unless the basic skills for the particular task have already been acquired.

This learning by imitation has two decided advantages over a pure trial and error approach : (1) It enables the learner to save time and effort which might otherwise be wasted in making incorrect approaches. Seeing a skilled performance saves a great deal of time which would otherwise be spent in trial and error. (2) Observing a skilled performance not only gives a general orientation but also gives certain insight into the problem at the start alone which may otherwise come only

after a long process of trial and error learning.

## TRANSFER OF TRAINING

Learning of one skill often influences the learning of another skill. This influence may be either positive or negative. (1) If the first learning facilitates the second one, it is known as *positive transfer*. (2) If the first learning interferes with subsequent learning and retards the progress of the latter it is known as *negative transfer* or *habit interference*. For ex:- A man who has learnt to type on a special kind of keyboard finds it more difficult to learn to use a standard key board. Transfer takes place (positive transfer) from one material to the other within the same class of materials. For ex:- Learning mazes, word list, poetry etc., usually affect favourably learning of the other samples of the same class of materials. In fact the educational programmes in schools and colleges are based on the belief in the possibility of transfer of training. In our educational system it is believed that if a student learns English or Kannada or Hindi it improves his memory power for learning other subjects taught in those languages. Learning such subjects for the sake of training to the mind is called *formal discipline*. The main principle behind education is the idea of formal discipline by which the training obtained in one subject or group of subjects could be transferred to other activities. For ex:- Training given in physics, chemistry, and mathematics upto pre-university education constitutes the formal discipline which aids or facilitates higher training in engineering, technology and medicine.

### Bilateral Transfer

Bilateral transfer or cross-education is another form of positive transfer of learning in which one part of the body facilitates learning by another part of the body. For ex:- Learning to trace the star pattern in the right hand facilitates learning to trace the same pattern in the left hand, (Mirror tracing board).

Ewert in one of his studies on bilateral transfer of training selected two equivalent groups of subjects— (1) Controlled

roup. (2) Experimental group. He has used mirror drawing apparatus for this study. First both the groups were given one trial each with the left hand i.e. each subject was instructed to trace the star pattern in the left hand by looking at its reflection in the mirror. The errors committed and time taken by each subject were recorded separately. Then the subjects of the controlled group were given complete rest and no training was given in the interval. Whereas the subjects of the experimental group were given about 50 trials to trace the star pattern in the right hand. After the training both the groups were given another trial in the left hand.

From the above experiment it is found that—(1) the controlled group had committed in the second trial 45% of the errors committed during the first trial. In other words 55% of the errors were dropped out in the second trial even without intervening practice with the right hand. (2) Whereas the experimental group which was given intervening practice in the right hand committed in the second trial only 26% of the errors committed during the first trial in the left hand. In other words 74% of the errors were reduced from the first trial to the second trial. (3) The difference of 19 errors between the controlled group and the experimental group is in favour of experimental group. (4) When time score is compared between the two groups it is found that the controlled group has reduced 46% of the time whereas the experimental group has reduced 82% of the time. The difference of 36 of time reduction from the first trial to the second trial is in favour of experimental group. Thus training in the right hand has helped reduction both in terms of time and trials.

#### Transfer to similar activity :

From the above discussion it is clear training to one hand facilitates training for another hand. Here we see that learning one activity facilitates learning another activity which is similar. In one experiment, the experimenter gave a paper pencil task in which the 'S' of experimental group was instructed to cross out rectangles connected with each colour circle. There were about 4 circles and 4 rectangles in each

design. After this training the 'S' was given discrimination reaction time experiment. The reaction time and errors committed were recorded for each 'S' and compared with other 'Ss' of controlled group, who were not given paper test training, before the discrimination reaction time experiment was given to them. Significant positive transfer effect was found with the experimental group of subjects.

### Transfer in given verbal learning :

Just as transfer of training is found with motor skills, we notice transfer even in verbal skills. When comparable lists of nonsense syllables are learnt one after the other, there, is a gradual reduction in the trials and the time required to learn the successive lists. An experiment was made on four groups of children having equal memorizing ability. First group was asked to memorize poetry, second group was asked to memorize tables, third group was asked to memorize the substance of a prose selection and the fourth group was asked to solve arithmetic problem which do not require memorizing. This training continued for three weeks. Each week, they were given the training for four days at the rate of 30 minutes a day. After the training all the four groups were asked to memorize the following materials-Nonsense syllables, prose selection, date of maps and other materials.

From this study it is found that (1) the children who were given training in poetry and tables have shown 66 to 85 more points in memorizing nonsense syllables than children who learnt the substance of prose selection and arithmetic. The improvement found with the above two groups is not due to improved memory but to the application of techniques learned with one material in order to learn the other. (2) On the other hand those who were trained with nonsense syllables showed negative transfer on learning the prose substances. (3) The transfer found to be short lived and the techniques adopted to learn will soon be forgotten. (4) Finally the attitude of concentration will soon be forgotten. Thus children who memorize one kind of material usually do not memorize another kind of material for which there is no previous training. If improvement occurs it is attributable to carry over of procedure

and attitudes.

### Bases of transfer :

Transfer of training, whether it is between motor skills or verbal skills, takes place subjected to certain principles. They are : (1) Similarity of contents. (2) Similarity of techniques. (3) Similarity of principles. (4) A combination of these,

(1) *Similarity of contents* : Parts of old habits may *run off* as a response to a new situation, with some modification if necessary. In the sense, if there is similarity between the contents to be learned and the contents already learnt, the old learning facilitates new learning. It helps to save both time and energy to a great extent. For example : if one knows driving a car, he can easily learn to drive a jeep or any other vehicle, because the brake under the right foot, the clockwise or anti-clockwise movements of steering, pressing the accelerator to speed up the vehicle, gear operation are more or less the same in all the vehicles. This similarity in content facilitates transfer of training. Similarly every subject taught in the school or college, will have similarity in contents. So every thing is conveyed to us through words and other symbols learnt earlier. In the same way a musician who knows how to play an instrument, learns another instrument more easily than a layman.

(2) *Similarity of technique* : Transfer depends upon the carry over of the technique. Technique refers to *learning how to learn or doing how to do or thinking how to think*. Learning scientific approach to a problem, helps to approach another problem in the same way. A student who has studied formal logic, thereafter thinks more logically and tests his thinking in terms of logic. Here the technique of formal logic is transferred to thinking. Similarly a student who takes a course on *how to improve memory* applies the techniques learnt, to his studies also. The application of technique involves insight into the problem.

(3) *Similarity of principles* : Transfer of principles is not always completely different from transfer of techniques, because the use of a technique may involve the application of principles. In one of the experiments on transfer of principles, a group

boys were given instructions on the principles of reflection, and another group was not given any instruction. Then both the groups were given mirror drawing test. Those who were taught the principles of reflection traced the star pattern with less number of errors and time. From this it is clear that transfer occurs where the principles are similar.

(4) A combination of these also facilitates transfer of training. Sometimes the combination of these bases is more facilitating than any one base.

### Conditioned Reflex

The term *conditioning* is used widely to mean *adjusted to* or *used to*. It is a process of connecting a new and unnatural stimulus to an old and natural response, which by nature are nothing to do with each other. For example : withdrawing the hand when fire is touched is a natural response to a natural stimulus; Similarly salivating when food is put into the mouth is a natural response to a natural stimulus. But making an individual to withdraw his hand when ready signal is given is conditioning. Similarly making a person to salivate at the bell is conditioning. Thus feeling hungry at the dinner bell fear of examination or of darkness or of an animal and food

habits, toilet training, cultural habits, normal and abnormal, behaviour are all due to conditioning. So conditioning or conditioned learning plays a very important role in our lives. Pavlov himself has claimed *different kinds of habits, based on training, education and discipline of any sort are nothing but a long chain of conditioned reflexes*. Though this is not completely agreed upon by others, many have felt, that the principles involved in the acquisition of conditioned responses play an important role in all learning. Dashiell has defined this conditioning thus- *if an indifferent neutral stimulus is presented one or more times, along with or just before an (natural) adequate stimulus to which the organism is responding in an appropriate way, the neutral stimulus may acquire potency to arouse much the same kind of appropriate behaviour. Thus the neutral stimulus becomes a signal standing for the adequate or natural stimulus.* This neutral stimulus must be sufficiently strong enough to catch the attention of the organism.

### **Pavlov's classical conditioning experiment**

The best known experiment on classical conditioning was performed by a Russian physiologist and Nobel prize winner Ivan P. Pavlov. He accidentally discovered the conditioned response, While performing a series of routine physiological experiments, in the early part of 20th century. He was studying digestion and salivation in dogs, which he called *psychic secretion of the saliva*, He made a surgical opening in a dogs cheek and inserted a tube to direct saliva into a glass beaker to collect and measure the secretion of saliva. To stimulate saliva he had arranged to put meat powder into the dog's mouth and observed its salivary response to the food.

He had engaged an assistant to serve food and to take care of the dog. Pavlov believed that placing food in the dog's mouth causes salivation in the mouth and gastric secretions in the stomach. As the experiment continued, the dog started showing saliva at the *sight of the food alone*. Then at the sight of the dish, the assistant and even at the approaching sound of his foot steps. This phenomenon has caused a

reat curiosity in Pavlov and changed the course of his investigation.

When the food is put into the mouth salivation is a natural response, because it causes chemical arousal of the sense receptors in the tongue and mouth which promotes digestive process. Whereas salivation at the very sight of the food or dish or the servant, is not natural but learnt one. So he thought that if salivary response could be attached to the sight of the food alone, it can be attached to any stimulus which is nothing to do with response by nature. He called it "condition reflex". He said conditional because it depended on environmental conditions.

In order to test this hypothesis he brought a dog and trained it to fit into the experimental situation. A few hours before the experiment, he made the dog to starve and brought it to the laboratory. He presented *metronome sound* for a few seconds and then offered the food. After an interval of few minutes he presented the combination of metronome sound and food in the same sequential order. He continued the experiment for a few more trials following the same procedure. The dog which showed salivation to food in the early trials, started salivating even at the *metronome sound*. In order to check up whether the dog is salivating at the duration of the sound or at the sound as such. He varied the duration of the sound from trial to trial and confirmed that the salivation was to the sound and not to its duration. Thus the stimulus sound and the response salivation were associated with each other by means of conditioning. Here the dog has learnt that food always follows sound. He concluded that if the dog could be conditioned to sound it can also be conditioned to any other neutral stimulus or unconcerned stimulus. But the conditioned stimulus should be sufficiently strong enough to cause attention towards it. To quicken the conditioning process the unconditioned stimulus should be strong and the interval between the conditioned stimulus and the unconditioned stimulus should neither be too long nor too short.

In Pavlov's terminology *food* is the *unconditioned stimulus* because it evokes the response of salivation by virtue of its nature. The short form of unconditioned stimulus is UCS

or US. The response of salivation to UCS is known as *unconditioned response* because it is not learnt by conditioning process, rather it occurs naturally. The short form of it is UCR or UR. The term *conditioned stimulus* is applied to any stimulus that evokes a response not previously associated with the stimulus. This neutral stimulus by virtue of preceding the unconditioned stimulus gains potency to provoke response which is naturally shown to an unconditioned stimulus. The short form of conditioned stimulus is CS: The metronome sound in this experiment is conditioned stimulus. Finally the term *conditioned response* refers to the response which becomes associated with the conditioned stimulus due to the conditioning. Conditioned response is the response shown to conditioned stimulus. The short form of it is CR. The salivation shown to metronome sound in this experiment is the conditioned response. The conditioned response in the classical conditioning is not different from the unconditioned response. The CR occurs because of fusion and confusion of the conditioned and unconditioned stimuli with each other, in the mind of the dog. The whole procedure adopted by Pavlov is called *classical conditioning or pavlovian conditioning*. Sometime it is also known as respondent conditioning, because the unconditioned stimulus follows the conditioned stimulus no matter what the S does. Further conditioned response markedly resembles the unconditioned response and it is ineffective.

Pavlov's studies have had a widespread influence on the development of psychological thought especially on learning. The process of conditioning has been demonstrated experimentally in countless experiments with both animal and human subjects. The conditioned response has become a fundamental concept in modern psychology.

### **Pavlov's laws of conditioning**

Pavlov in order to explain how conditioning takes place has postulated the three laws: (1) Law of contiguity (2) Frequency, (3) Reinforcement.

(1) *Law of contiguity*: According to this law, conditioning takes place because the CS and US are presented close together.

her in terms of time. This contiguity of time makes the animal to fuse and confuse the CS with US, and to show the same response to CS as shown to US. If time sequence is removed conditioning does not take place.

(2) *Law of frequency* : According to this law, the repetition of the combination of CS and US for a number of trials not only establishes the relationship between the CS and CR but also strengthens the bondage between the two. This is also known as the law of exercise.

(3) *Law of Reinforcement* : According to this law, a response to become conditioned, the conditioned stimulus must always be presented with or followed by, the unconditioned stimulus. The pairing of the conditioned and the unconditioned stimuli is referred to as *reinforcement*. In the above experiment the unconditioned stimulus or food is the reinforcement.

In classical conditioning reinforcement plays a vital role. Without the reinforcement, if only the conditioned stimulus is presented, conditioning does not occur. Even after the conditioned response has been established, withdrawal of reinforcement causes the conditioned stimulus to lose its power to evoke the response. In short it not only promotes the establishment of relationship between the CS and CR but also strengthens it. Any reward acts as a reinforcement with the needy organism. The speed of conditioning depends upon the size of the reinforcement, how soon it is presented and how often it is presented.

There are several measures of conditioning that can be used to plot the course of acquisition. They are : latency, magnitude of response, and probability of response. *Latency* refers to how quickly the conditioned response occurs after the conditioned stimulus is presented. *Magnitude* refers to the strength or size of the response. *Probability* refers to the proportion of time that a conditioned response occurs when the conditioned stimulus is presented.

#### Several phenomena under conditioning :

Some of the phenomena we come across in conditioning are : (1) Stimulus generalization and discrimination or selective conditioning. (2) Extinction and spontaneous recovery. (3) Negative conditioning (4) Delayed conditioning.

**(1) Generalization and Discrimination :** After conditioning the dog to salivate at the sound of a particular bell, it responds with saliva to bells of different sounds or even to buzzer. In the same way Watson's child Albert who was made to show conditioned fear for a toy rabbit, started showing the same fear towards all animals with fur. This phenomenon is known as *stimulus generalization*. The tendency to generalize or to confuse stimuli is greater, early in the training period than later. Generalization occurs most readily for stimuli of the same sensory modality such as, two auditory stimuli or two visual stimuli. Sometimes it may also take place between stimuli of different modes. In general there is less stimulus generalization as stimuli become more dissimilar (Brogden 1951). In human beings this phenomenon is related to age and ability to discriminate between stimuli. For example : it is more with children than with adults. Just as stimulus generalization, *response generalization* also occurs in conditioning. For example : Animals trained to press a lever with one foot, if that foot is tied down or restrained, it will press the lever with another foot or with head.

The specific conditioned response of the organism to one stimulus and not to the other stimulus which is similar is known as *discrimination of stimuli*. This discrimination is due to the accompaniment of reinforcement (US) with one stimulus and not with the other of similar type. The capacity to discriminate the stimuli is limited with animals. The stimuli with subtle differences cannot be discriminated. If forced upon the animal develops *experimental neuroses*. Even man when subjected to severe conflict and consequent stress, develops neuroses or psychoses.

**Extinction and Spontaneous Recovery :** Temporary suspension or inhibition of the established conditioned response is known as *extinction*. This extinction occurs because of repeated presentation of the conditioned stimulus without the accompaniment of the reinforcement. For ex : salivary response shown to metronome sound due to conditioning, disappears gradually and temporarily, if the experiment is repeated with only the conditioned stimulus, without the accompaniment of reinforcement.

The phenomenon of extinction like positive conditioning is a process of becoming adjusted to a temporary situation. The metronome sound which acts as *signal* for the arrival of food in the positive conditioning, also act as a *signal* for non-arrival of food in the experiment on extinction. The extinction of CR refers only to classical conditioning and not to the instrumental conditioning.

The principle of extinction can be made use, to eliminate certain undesirable or abnormal behaviour of children as well as adults by eliminating the reinforcing factor. Ex : smoking, drug addiction, alcoholic addiction and phobias. This is one of the techniques of behavioural therapy.

The sudden re-occurrence of the CR during extinction is called *spontaneous recovery*. This can be obtained either by introducing reinforcement along with the CS for one or two trials or by some rest pause after extinction of CR. The spontaneous recovery is better if the rest pause is longer but not too long.

(3) **Negative conditioning** : Fundamentally negative conditioning is the same as extinction. In both we see a gradual elimination of useless or undesirable responses to a repeated stimulus. But negative conditioning is more a deconditioning than mere temporary suspension of undesirable conditioned response. Negative conditioning is also negative adaptation to undesirable situation. It involves substituting a desirable response to the undesirable or tolerance and adjustment to the undesirable or exhausting and eliminating the undesirable or changing the environment which is conducive to undesirable conditioned response. Thus there are four methods of negative conditioning or deconditioning the undesirable response which is conditioned. Such as (1) Method of incompatible response, (2) Method of exhaustion, (3) Method of toleration, (4) Change of environment. By adopting the procedure of negative conditioning many forms of undesirable behaviour can be eliminated. Such as nail-biting, phobias, enuresis (bed-wetting) drug addiction, alcohol addiction etc. Behavioural therapy is based on the principle of negative conditioning.

(4) **Delayed conditioning** : Learning to show the conditioned response at the tail end of the conditioned stimulus instead of showing it from the beginning of CS is known as delayed conditioning. If the conditioned stimulus (bell) is presented for one minute and then food is given, the conditioned dog starts salivating for the whole minute of delay. As the trials continue the conditioned response begins to appear almost at the tail end of the minute. This shows the adjustment of the dog to the timings of the stimuli. Here we find two phases in conditioning i. e., the inactive preparation for a long wait and then active preparation for receiving food.

(5) **Higher order of conditioning** : Sometimes a neutral stimulus can become conditioned stimulus by being paired with an already established CS. This procedure is known as "higher order of conditioning". For example; when the dog has learnt or conditioned to salivate to bell, start presenting a flash of light before ringing the bell. Repeat this pair of bell and light after a few trials the dog learns to salivate to light alone. The amount of salivation may be less. In the same way words acquire their emotional meaning through the process of higher order of conditioning. If they are paired with objects or other words which have already conditioned to elicit the same emotional response, they too may elicit the same response. This higher order of conditioning is difficult to demonstrate in the laboratory. Procedure for higher order of conditioning –

- I) Light + Bell → Dog salivates
- II) After conditioning - Light → Salivation

#### Conditioned responses in human beings :

An attempt was made to study the process of conditioning in human subjects. So babies are tried with buzzer-bottle sequence to condition sucking response to buzzer. Before the bottle is given, buzzer sound was produced and then bottle is given to the baby. After a few trials spread over a few days, the babies showed signs of conditioning i. e., they stopped crying at the buzzer sound and made sucking movements. Conditioning becomes easier and easier and quicker as

the child advances in age upto four years. Beyond that they become less and less conditioned.

Although the salivary CR can be experimentally established in some adults it is not so dependable as it is in dogs. So psychologists have tried to establish motor responses like withdrawal of hand from shock, knee jerk at the stroke of rubber hammer, winking reflex to the flash of light and eyelid reflex to a puff of air etc. All these experiments have proved the process of conditioning in human subjects. CR plays an important role in the control of bladder and rectum, in the emotional expression of face, breathing, blood-pressure, heart beat etc.

### **Classical conditioning and the real world :**

Classical conditioning plays a significant role in our every day life. The role goes far beyond the learning of simple observable reflexes. Infact our habits, our liking or disliking of a thing, or a person, our love towards parents and others, our social, cultural, moral and spiritual activities are based on classical conditioning. Thus we can cite hundreds and thousands of examples to demonstrate the role of classical conditioning in our day-in and day-out activities.

As said already our emotional responses are learned by conditioning. They can also be unlearned by reversing the processes appropriately. The Principles of "extinction and alterations" of disturbing emotional responses by classical condition is a form of 'behaviour therapy or behaviour modification. This technique is used to make children and adults either to learn or unlearn many habits.

**Accounting for taste :** Probably we learn to like or dislike many things through a process of classical conditioning. "M" was disliking slaughtering or killing animals, but he was liking chicken and chicken preparations. One day a chicken was cut in his presence and dressed to prepare curry. After preparing curry let alone eating it, he could not even withstand the sight and smell of chicken curry and other chicken preparations. This aversion to chicken preparation continued for years.

"I (author) had no idea of "sapota" a fruit with mud colour. I was not eating because of its colour. One day its outer cover and seed was removed and the fruit was given to me. I found it be tasty. From then on I am liking sapota fruit. Same thing happened to me regarding butter fruit also.

Some children do not wean breast feeding for years (2 to 3 years). They refuse bottle feeding or spoon feeding. In order to wean breast feeding mother applies some bitter solution or juice to her breast nipples. Whenever the child sucks, it will have bitter taste and gives up sucking. Repetition this procedure weans the child from breast feeding.

People develop smoking and drinking habits in the same way. Hostel boarders gradually show conditioned learning to dinner bell after staying in the hostel for sometime.

**Accounting to blind belief :** Individuals by birth will have neither belief nor disbelief in religion or superstition. Parents and teachers by exposing the children to religious activities and telling stories about sins, heaven, hell and punishment they will have to receive in hell, condition the children to learn and practice religious activities with fear of punishment behind. Our development of ego and super ego to control and to regulate our behaviour from within or without is also based on conditioned learning.

In the same way we develop many "blind belief" and superstitions about various things in every day life. For example ; Parents tell children to see the photo of God when they wake up otherwise something bad happens in the course of the day. They also advice to turn to their right and then to get up from bed lest some bad thing happens. Accidentally if something bad happens to them on that day they immediately believe that it happened because they did not see Gods photo when they got up or they got up left side. Thus they connect the two together by "going from effect to cause" In the same way we learn to respond with fear when cat goes across us. Touch wood also belong to this group. These blind beliefs learnt by conditioning, affect us badly though there is no scientific basis behind them.

Some time we subjectively like something but our bodies

refuse to tolerate it. This is true with "allergic reactions. Certain allergic reactions may be classically conditioned. People may learn to be allergic to certain neutral substances that have been associated with, something to which they are already sensitive. For example-(1) My mother an old lady of 80 years was liking brinjal but was afraid that it causes bleeding with motion and burning sensation in the stomach and eyes etc. But it was only a belief that she had learnt by conditioning. To test her reactions we used to put a brinjal with tuar dal to prepare curry. If she were to see pices in the curry, she used to show those reactions automatically. For a few days we were putting brinjal with dal but removing all the pices while serving her. On all those days she was not showing any allergic reaction after lunch.

(2) My friend's son had allergic cold-running nose and sneezing. For what substance he was reacting was not known. But he was reacting to banana, buttermilk, oil bath, walking in chill weather etc. So he was avoiding all these things. Actually he was not allergic to all these things earlier but in course of time all of them have become conditional stimuli. After treating him with "vitamin C" for a fortnight exposed him to all those conditioned stimuli along with the "suggestion that they do not affect him in any way". Accordingly he was able to withstand all those stimuli gradually. Thus he was deconditioned to all those substances.

(3) "I (author) was allergic to dust and chill weather and hence reacting with cold and sneezing. I was to learnt all other things. One day I had to clean the room where we were storing the books. After that I sprayed DDT powder as a protective measure. Immediately I started reacting with cold and sneezing. Never in the past I had reacted to DDT. Because of pairing of dust and DDT I started reacting to DDT there after. Thus this, classical conditioning caused in me allergic reaction to DDT.

**Classical Conditioning and Impotency :** One day a middle aged married man of 48 years came to me (Author) and confided his problem of "impotency" from six years. Till then he was leading a normal sexual life. He started narrating various pleasant and unpleasant incidents and experiences. In

the course of it, he mentioned the problem of fissure and piles in the rectum. These were not serious for two years. Some body advised him not to undergo operation as it may lead to complications' So he was taking only medical treatment. After two years the problem became more and more accute, One night when he got sexually excited, and his genital erected, his sphincter muscles of his rectum started contracting rhythmically and caused a lot of pain, This fear of pain or (anxiety) suddenly cool-down his excitement and he could not have sex. He had the same experience another two three times and he experienced sexual failure. This failure caused anxiety. Though the whole thing was repressed with the lapse of time The repressed anxiety (CS) caused impotency (CR). The whole process can be explained in the language of conditioning—

- 1) Sexual excitement(US) → Pain (UR) → fear of pain (CS) → Failure of sex (CR)

- 2) — Fear of pain (anxiety) CS → sexual failure(CR)

After tracing the relation between piles and Impotency he was suggested to under go operation of fissure and piles, so that there may not be pain any more when "erected" and he can lead normal sexual life again. I am awaiting for the result (Author 1994).

Some individuals are rexually aroused by "fetishes". Normally objects or parts of the body are not associated with sex. A fetish is one who initially acquired an appeal for an object or part of the body of the opposite sex, This object usually belonging to an opposite sex. Due to it's association with an unconditioned stimulus, gains poter.cy to arouse sex and satisfaction. For example; in one case, a Fetish had broken his leg when he was a boy. When he was in the hospital for treatment he was attended by an attractive nurse. It was she who held his leg when it was set and plastered. This was sexually stimulating to him. When he grew up, he had to wear a plaster cast in order to become sexually aroused. (Tollison & Adams 1979).

Classical conditioning may also explain "Masochism" and "Sadism". In "masochism", the person enjoy by subjecting to pinprick or shock caused to others specially the opposite sex. Woman is said to be masochistic. Normally biting, pinching,

or hitting is painful. When it is done by opposite sex it gives pleasure and satisfaction. Here a painful stimulus by being associated with an unconditioned stimulus for pleasure or satisfaction later on gives pleasure directly.

In the same way in "Sadism", the sadist enjoys by hurting, paining, criticizing or teasing the opposite sex or a person who is assumed to have caused trouble. Though, hurting or paining others does not by itself gives pleasure but it's association with the person who has caused trouble, acquires potency to give pleasure by hurting any body.

A new born baby is "selfish" or "selfcentered". It is more concerned with its satisfaction of its needs and pleasure. Such an organism, when its needs are satisfied by some body (Mother), it starts "liking or loving" the mother, because of its association of mother with need satisfying agency. Mother in addition to satisfying its needs and offering protection, also strokes and cuddles the baby. Mother's hugging, caressing, fondling, kissing etc. makes the child to associate mother with those things, and starts loving mother. Later on others at home doing the same thing to the child, makes the child to love father, siblings etc. Thus learning to love parent or parents is really not different from learning salivate to bell, light etc. Similarly loving wife emerges because she satisfies his basic needs-hunger, thirst, sex etc. In the same way wife loving her husband is based on satisfaction of her basic needs, and security,

**Conditioned Fear and phobias :** Apart from conditioning of positive emotions, negative emotions—such as fear and phobias, are also classically conditioned. Here the original conditioning incident or incidents may be forgotten, but the emotion remains long after its origin has faded away. Watson cites an example of Albert "a child of 11 months old. This child was rather placid, good natured, and rarely cried. Watson and Rayner (1920) deliberately established a rat phobia and phobia to all animals with fur. This child had no fear of any animal let alone rat, but had an innate fear to loud noise. He placed before the child a toy rat to play. It was very much delighted.

when it was about to reach it one of the research workers struck a steel bar suddenly and produced a loud sound. As usual the child startled and fell on the mattress. The child was pacified and placed the toy rat and repeated the same procedure several times. Then the child Albert began to whimper and tremble. Finally the child was offered the same toy rat but not the loud sound. However Albert at the very sight of the rat fell over, cried, and crawled away as fast as his little legs could carry him. Thus the rat had become a conditioned stimulus (CS) for Fear (CR). Further the study revealed that Albert's fear generalised to other furry objects, such as white rabbit, cotton wool, Santa claus mask, man with beard etc.

In the same way, except the fear of sudden loud sound and loss of balance, fear towards all other animals, darkness, water, blood, open space, closed place, high place etc. are acquired by conditioning processes. Apart from the fear cited above children and adults also develop "phobias". Phobia is nothing but fear to a situation or animal etc., In addition to it phobia more intense, irrational, and unproportional to the stimulus and hence it paralyses the individual. Phobias are also acquired by conditioning process. For example; Acquaphobia—intense fear of even knee deep water, Nyctophobia—terrible fear of darkness etc. The phobias can be removed by hypnotherapy or desensitization technique. The other details of phobia and the techniques of eliminating them are discussed in the last chapter of part-2 psychology.

### Instrumental Conditioning :

Bechtrev a reflexologist, who was a contemporary and rival of Pavlov, was not satisfied with Pavlov's classical conditioning experiment on dog. The dog's response of salivation was glandular reflex which plays a passive role in getting reward or the reinforcement. Neither it does something nor learns something to adjust itself to the environment. As against this Bechtrev conducted an experiment with human beings who have to show either avoidance or approach as a consequence to conditioned stimulus which is followed by unconditioned stimulus. He used an electric shock as US and bell as CS.

CS. The response expected was lifting the foot. The subjects learned to lift the foot at the sound of the bell. This conditioned response is effective or instrumental to avoid shock. Thus he paved the way for introduction of *instrumental conditioning*. Later on instrumental conditioning experiments were conducted on animals by a number of investigators. Learning all sorts of mazes, avoiding punishment, learning specific activities leading to reward such as food or escape, have all been experimented by this technique of conditioning. Thus this method came in handy to study the basic principles of all forms of learning. Several aspects of learning process have been brought out by these experiments on instrumental conditioning. They have shown that learning is not merely connecting a response to a condition stimulus but also a process of reducing diffused movements and giving rise to specific response to a stimulus or a situation which helps the organism to adjust more effectively.

### Skinner's experiment on instrumental conditioning

Skinner in order to demonstrate fundamental principles involved in most learning activities conducted an experiment on instrumental conditioning, using rat as his Subject (S). He kept a hungry rat in a box which is known as *Skinner box*. Except a small tin container in a corner, the box was empty. Outside the box a small machine was fixed. The operation of the machine delivers a pellet of food through a chute into the food pan making a tinny noise. After the rat has adjusted to the empty box Skinner operated the machine and delivered a pellet of food. The hungry rat being disturbed by the tinny noise, explored the box found a pellet in the container and ate it. A few minutes later he delivered another pellet into the pan. The rat approached the food pan more promptly than before. With a few more trials the rat learnt to approach the food pan straight. Thus the rat learned an  $S_1$ -R<sub>1</sub>, S<sub>2</sub>-R<sub>2</sub>, sequence. In other words it has learned the sequence of CS-CR US-UR. In this sequence S<sub>1</sub> (CS) is tinny noise. R<sub>1</sub> (CR) is approach to the food pan. S<sub>2</sub> (US) is the food and R<sub>2</sub> (UR) is eating. Here R<sub>1</sub> is a preparatory response and it can be called

an instrumental CR because it acts on the environment to secure food.

In order to confirm whether the rat has learnt the sequence, Skinner complicated the experimental setup a little more. He introduced a horizontal bar along a wall of the box near the food pan. He connected the horizontal bar with the machine outside the box in such a way, that the pressing down of the bar delivers a pellet of food into the pan. The hungry rat while exploring the box encountered the bar. Accidentally it pressed down the bar with its paw. Immediately a pellet of food was delivered into the pan with tinny noise. As it had already learnt to respond to the tinny sound it ran to the pan, saw the food and ate it. The experiment was repeated for a few more trials with the hungry rat. The rat had learnt to press the bar to deliver a pellet. Here the sight of the bar is S (CS) and pressing the bar is R<sub>1</sub> (CR). This CR was established with the help of reinforcement (food). Here the CR is instrumental to get food. This CR can be extinguished by withdrawing the reinforcement. The extinction of instrumental CR requires more number of unreinforced trials than Pavlov's classical CR.

This experiment of Skinner on instrumental conditioning is similar to Thorndike's experiment on cat. The difference is that the Skinner's box is simpler than Thorndike's puzzle box. As the false leads were very few, exploration was easy and learning was quick. Just as the rat in the Skinner's box, Thorndike's cat in the puzzle box learns the sequence of S<sub>1</sub>-R<sub>1</sub>-S<sub>2</sub>-R<sub>2</sub>. In Thorndike's experiment S<sub>1</sub> is the sight of the door button, R<sub>1</sub> is the act of manipulating the button, S<sub>2</sub> is the food and R<sub>2</sub> is the act of eating. We also see the same sequence of learning with Pavlov's dog i. e, S<sub>1</sub>-R<sub>1</sub>-S<sub>2</sub>-R<sub>2</sub> (CS-CR-US-UR). S<sub>1</sub> is the metronome sound, R<sub>1</sub> is advance flow of saliva, S<sub>2</sub> is food in the mouth and R<sub>2</sub> is reflex flow of saliva aroused by food in the mouth. From the above sequence of learning with Thorndike's cat, Pavlov's dog and Skinner's rat, the Skinner's experiment on instrumental conditioning bridges the gap between Thorndike's trial and error learning and Pavlov's classical conditioning which were regarded totally different from each other. All the three involve the learning

of a sequence. In all the three the meaning of a stimulus is learnt, since a stimulus becomes a *signal* indicating what is going to happen next or what can be had by making a certain reaction.

## Difference between classical and Instrumental conditioning

Though the principles involved and the sequence learnt in classical and instrumental conditioning are the same, they differ from each other in certain respects (Munn 1966) such as:

(1) In classical conditioning the early CR is the duplication of UR (i. e., both are salivary responses. Whereas in instrumental conditioning either the early CR is modified or becomes specific rather the CR and UR are different from each other.

(2) In classical conditioning the CR is ineffective and it does not lead to final response. In the sense, whether it salivates or not it secures food. In the instrumental conditioning the CR is effective and instrumental to secure reward or reinforcement. Example : Unless the rat runs to the food pan or presses the horizontal bar, it does not get food.

(3) In classical conditioning the preparation for final act of salivation to the supply of food, is done by experimenter i. e., the dog must be starved to respond, whereas in instrumental conditioning the preparation for the final act is done by the unconditioned stimulus.

(4) In instrumental conditioning the early gross movement become specific as the trials advance. But in classical conditioning no such observable changes are noticed. This reminds us of the fact that learning involves modification in the response but not just attaching a response to a new stimulus. This response modification can be noticed in trial and error learning.

(5) Instrumental conditioning reveals the initial and final stages of learning more clearly than classical conditioning.

In view of these differences which were in favour of instrumental conditioning Bechtrev and others have worked on instrumental conditioning and have stressed its importance in explaining learning processes.

In spite of these differences between the two types of conditioning, they are not completely different processes, rather they form a continuum. Both of them are subjected to same laws of reinforcement, extinction, spontaneous recovery discrimination etc.

### Application of Operant or Instrumental conditioning :

In classical conditioning the behaviour occurs following an event or a stimulus. For example ; salivation occurs when food is placed into the mouth and later on when bell is presented (after pairing unconditioned stimulus with conditioned stimulus). Thus we see transfer of a response from one stimulus to another. Classical conditioning is passive, and the behaviour is to be elicited by an unconditioned stimulus.

In the case of "Operant conditioning", (used by B. F. Skinner) The behaviour brings about the desired result. The result is the reward. For example; student stop making noise to avoid scolding. Child stops crying to avoid punishment, Actions like these are called "Operant behaviour". They are designed to operate on the environment in a way that will get a reward or helps to avoid punishment. To understand operant behaviour we have to understand "Operant conditioning". In operant conditioning the correct responses are reinforced and incorrect responses are either ignored or punished. For example :

(1) A two years child who is frustrated by his inability to get what he wanted has started banging his head against the wall. To avoid concussion many parents immediately get him what he wants. But one mother who faced this situation, took the child's head in her hand, pulled it towards the wall and said "here, let me help you do it". She understood that the child is hoping to upset her and to get what it wanted from her. By refusing to come across with the unexpected response, she foiled his plot. Surprisingly, he stopped banging his head against the wall and never did it again. No doubt that mother's strategy worked out in this case but it does not work out in the case of disturbed child, or with one who had a history of getting attention by banging head

against wall. The right thing to be done is to ignore the undesirable behaviour to get attention or to get what he wants. He must be made to understand that the behaviour shown to get what he wants does not yield the desired results. Then only he gives up.

Ex : (2) In one case, the author's nephew (Brother's son), was showing a lot of temper tantrum, by crying, holding his breath, falling down etc. Parents were afraid of this strange behaviour shown by the child and they used to get him what he wanted. One day this nephew, in the presence of this author demanded his father to give him the thing he was holding, only to destroy it. The author told him not to give him the thing. Child's father was in a conflict "to give or not to give." He wanted to yield to the child's demand because he knew the consequences. He told his concern to the author. The author told his brother not to yield at any cost and to leave the rest to him (author). As expected the child started crying in high pitch, held his breath, turned blue and fell down. The author was watching the whole drama. The child became conscious after sometime and continued crying. He continued crying for nearly one and a half hour sitting in the same place. Finding no response from his father and the author and being tired, child said that he will not cry again. After repeating it a few times, the child was allowed to go. After meeting the same treatment for two days, the child realised that it is of no use to show temper tantrum to get what he wanted. The child's behaviour which was yielding the desired result hitherto, now realised that it has no value and gave up that behaviour from then on. So, the only thing to be done is to withdraw the reinforcement which is prompting the undesirable result. The behaviour appears to be of no consequence.

Operant conditioning occurs when the organism operates or produces effect on its environment. If the desirable behaviour is to be learnt and strengthened, the reinforcement (Reward) is to be continued for sometime. If the undesirable behaviour is to be eliminated the reinforcement is to be either withdrawn or punishment within tolerable limits. These

principles can be applied in any walk of life and more so in class room.

### Behaviour Modification in Education :

**Classroom behaviour :** Learning principles are to be taught in every teacher training programmes. More and more principles of "behaviour Modification" are to be used in the classrooms to discipline the students. Teachers as behaviour modifiers have to encourage some behaviour and discourage certain other behaviours. To discharge such a responsibility, they have to select and provide reinforcers and punishers, they have to decide on the appropriate schedule of reinforcement, evaluate the effectiveness of the conditioning and if necessary change the programme accordingly to suit the situation and the person. While analysing behaviour of the child the teachers should not simply say "The child is stubborn or hyperactive". Precise description of behaviour is to be given, such as 'Ignores the instructions to work quietly', 'Not attending the classes regularly', "Disturbs other children", "Very much talkative". Only then behaviour modification can be applied, appropriately", reinforcement is to be carefully applied.

**Example :** If a 3 years old child of nursery school, instead of walking if she "Crawls" or "Crouches" on the floor with her face hidden, the child should not be punished or threatened to give up crawling but to walk. Rather teacher has to pay attention to her when she behaves normally and ignore when the child crawls. This makes the child to give up crawling and to start walking.

**Shaping :** Shaping or step-by-step conditioning is an important tool in behaviour modification in schools and especially to deal with problem children. For example, shy child can be taught to be more active socially by giving him a coin or a pat on his back, when he "makes any sound" first; Then for "uttering syllables" and ultimately for "mixing and communicating".

Punishments like beating, shouting, and frightening the child makes the school a place to be feared and not a place to

learn. Some children take punishment as reward because they get little attention when they are not misbehaving. "Don'ts" work best when backed up by "Dos". Activities can be used as reinforcers. For example, Rewarding 15 minutes play after successfully finishing their lessons. This does not cost anything to school management financially.

**Token economy :** This is a specific form of behaviour modification. This is used in factories, business organization, and some hospitals. In TE the child whose behaviour is to be modified is to be given play-money or plastic chips as reward for good behaviour or scholastic achievement. These tokens can be exchanged for primary reinforcer—say a candy, a balloon, a toy etc. Child who earns token feels proud and it acts as immediate feed back. TE is very successful in stimulating short term changes in behaviour. The drawback is the reward or token may be misused or over used and it may have an effect on the behaviour to be developed. Example : certain tasks are "intrinsically interesting" and children do even without reward. But once they are rewarded, they expect reward everytime, and if not given they may not show interest in doing it. This is known as "rewarding to death". The activity becomes end in itself.

Behaviour modification is most effective in dealing with inappropriate behaviour if not reinforced unnecessarily earlier. The example of the child whose temper tantrum was ignored by the author (quoted above) proves to be very effective. The author has dealt with another girl child who was showing temper tantrum, very effectively and successfully in two sittings.

Finally behaviour modification specialists emphasize a positive approach. Better results can be obtained if emphasis is made in the behaviour to be acquired rather than behaviour to be eliminated. Further changing the environment if necessary, to get better results.

### Maturation and Learning

The physiological system with sense organs and cerebral cortex is the basic equipment for learning. So its development and maturation has an important bearing on learning

process. Without the maturation of the concerned structure or structures any amount of training is of no use. For example : any amount of training given to a baby of six months to walk, cannot make it to walk. The concerned muscles, nerves and motor area of the cortex should mature for the child to walk. Only when certain amount of maturation is reached training given will have certain value. Similarly most of our learning activities depend upon the stages of maturity reached by central nervous system and the muscles.

As the individual matures, his innate potentialities unfold themselves. These changes do not depend upon learning but are necessary to make learning effective and efficient. During early childhood the learning ability depends upon the maturation of the cerebral cortex. Especially complex learning which involves symbolic process necessitates maturation of the cerebral cortex and its associated area.

The degree of maturation necessary for a particular training to be effective is known as *learning readiness*. Without the attainment of this if the child is pressurised to learn something which is beyond its physical, intellectual, social and emotional developments it will be not only loss of labour but also injures the child severely. So before the child is taught the skills like reading, writing and arithmetic it is necessary to ascertain the learning readiness. The rate of maturation differs from child to child.

In this connection it is appropriate to recall a study of Arnold Gesell and Thomson on identical twins. When the identical twins "T" and 'C' were on the verge of climbing activities, child "T" was given training for six weeks at the rate of 10 minutes a day, whereas child 'C' was not only denied of training but also prevented climbing stairs. At the end of 6 weeks training given to child "T" child 'C' was also given a short period of 2 weeks training and the performances of the twins were compared. It is found from the studies that (1) in the initial test child "T" was more skillful but "C" had managed to climb the stairs unaided. Of course it was not very skillful. (2) Two weeks later 'C' became equally efficient in climbing.

Dennis has studied locomotor development of Hopi and *Learning*

Navaho Indian children. Hopi infant was tied down to a card board for first three months of life except for a brief interval of an hour per day. So it had no opportunity to develop locomotor movements. Yet these children showed the same developmental pattern in locomotion as the normal American children.

From these two and many other studies made in this line it is concluded: (1) That both maturation and learning contribute to locomotor skills, (2) A child which is not matured sufficiently will have little benefit by training, (3) Once the required level of maturation is reached, very little practice is necessary to walk or climb, (4) Training smoothens the performance and induces greater confidence in the learner.

## Remembering and Forgetting

### Introduction

Memory involves both remembering and forgetting. These two are like two faces of the same coin. They are like day and night in the life of an individual. Though they are opposed to each other by nature, they play very significant roles in the life of man. Remembering the unpleasant experiences or events makes living miserable. Whereas remembering the pleasant experiences often makes living pleasant and happy. So, for man to be happy, forgetting the unpleasant and remembering the pleasant experiences and feelings are equally essential. Especially for students good memory is a boon. If they have to progress in their studies and write well in the examination; remembering is very essential. If learning has to progress remembering of what is already learnt is indispensable. otherwise everytime the learner has to *Start from the scratch*. So, there will be no time left to learn the new skills. Further, if a person does not remember the past experiences of his environment, adjustment becomes very difficult. Thus there is a close relationship between memory and learning, and between memory and adjustment to one's environment. If all the unfortunate and unpleasant experience which are caused by

conflicts, frustrations and stresses in the past are not forgotten life becomes a battle field, and peace and tranquility become rare commodities. Such an individual sooner or later lands himself in the lunatic asylum. On the other hand if a person has good rememberance of the things he learns he can make a rapid stride in any walk of life. Behind all the greatest scientific and technological achievements in the world, we find the role of good memory in addition to intelligence and aptitude.

What we remember and what we forget, how much we remember and how much we forget are difficult to be assesed accurately. However, if the experiences are recent, pleasant, interesting and strong and which contributes to restoration of homeostasis, are easily remembered : On the other hand if the experiences are old, unpleasant, uninteresting and disturb the homeostasis, are difficult to be remembered. Rather they will be forgotten very soon because, they do not help to maintain or to restore homeostasis. Thus remembering and forgetting act as tools to maintain physiological or psychological homeostasis. The nerve cells are so structured that they undergo changes and help to retain what is learned in the form of memory traces. Any experience or feeling unpleasant will be ejected by the cells and thus forgetting takes place. So the object of remembering and forgetting is to restore and maintain homeostasis. This takes place consciously as well as unconsciously (author) Innumerable experiences we gain from every day dealings and the knowledge we acquire daily do not remain discrete in our mind. They are associated with each other according to certain laws of association. But at the outset these experiences or the ideas which we recall appear to be unconcerned with and unrelated to each other. A careful analysis of the thoughts recalled reveal the involvement of certain laws. The laws which govern these relations among the experiences or thoughts are : (1) Law of Contiguity, (2) Law of Similarity and (3) Law of Contrast.

(1) **Law of Contiguity** : According to this law any two events or incidents which take place simultaneously at a particular time or at a particular place, tend to associate with each other, either in terms of place or time. Thus association

is formed between the two mentally. As a result of this, recalling of an event, makes the associated event to occur to your mind automatically. Suppose you see an accident one day at a particular circle, later on whenever you go to that circle, you will automatically remember that accident. Similarly if you see an accident at 5 O' clock, later on every day or often at 5 O' clock you will remember the accident. This is so, because of time relation or place relation between the accident and the time or place. From this it is clear that the experiences or events which are contiguous to each other tend to associate with each other and hence they occur in chain. That is why chain of ideas occur to our memory by a single stimulation.

**(2) Law of Similarity :** According to this law the events or experiences which are similar to each other tend to associate with each other and hence recalling of one experience makes the related experiences to follow the suit automatically. Similarity of experiences may be in terms of time appearance, form, colour or size. Suppose you see a person who is similar to your friend in appearance you will immediately remember your friend and the other associated ideas.

**(3) Law of contrast :** Events, things or words which are opposite to each other tend to associate with each other and hence recalling of one makes the other to remember automatically. For example, white and black, good and bad, honesty and dishonesty are the opposite pairs of concepts. As they have a tendency to associate with each other in our mind, recalling of any one concept of the pair makes you to remember the other one automatically.

### Factors Involved in Memorizing

Efficient memory depends upon efficient learning methods. The suitability of the method of learning depends upon the time that is available to the learner and the goal he has in his mind. Suppose time at the disposal of the individual is short and the goal is a short term one, he has to adopt either the part method or the repetitive method or unspaced method. On the other hand if the goal is to remember for a long time, he has to adopt either the method of recall or the method of distribution or the whole method or the combination of any

two methods. Such methods are highly serviceable and efficient to learn and to remember better. Efficient learning involves four important factors such as, (a) factor of confidence, (b) factor of recency (c) factor of meaning, outline and broad relationship. (d) factor of consolidation through rest. Now let us try to know how each other factor contributes its share to make learning efficient.

(a) **Factor of confidence** : Any learning to be effective and to progress rapidly, must provide the learner some confidence in his attempt. This feeling of confidence comes from the knowledge of result and this facility is found only in part method. In the part method the learner learns the material part by part. As he learns each part, he gains confidence and proceeds to the next part with great vigour and learns faster. Though the whole method is advantageous in certain respects it lacks the facility of confidence. Until the learner learns the whole material, he will not be knowing how much he has learnt after each trial. The lack of knowledge of results does not fill in confidence in the learner and hence learning will be slow. Even after reading the same material for a few trials, he does not know how much he has learnt by then : Hence sometime he feels the whole thing is a waste. Apart from the part method which fills in confidence in the learner, the method of recall after each successive trials, provides the knowledge of results, which fills in confidence with the learner and makes learning faster and better. Thereby it makes memory more clear and long lasting. Thus efficient learning method fills in confidence with the learner and makes memory very efficient.

(b) **Factor of Recency** : Any experience which is recent or anything learnt recently has an advantage of being remembered better. So any learning which is connected with the recent experience can be learnt faster and better. This advantage is found in the unspaced and repetitive methods of learning. As there is no time gap between repetition of recent experience of each preceding trial, facilitates learning to progress in each succeeding trial. This makes memorizing easier and better. That is why it is said Strike while the iron is hot.

(c) **Factor of meaning, outline and broad relationships**

Anything learnt by understanding the meaning and relation of each part with the rest of the parts of the material, facilitates memorizing better. This is the most important factor of the four. But this facility is not found either in the part method or in repetitive method discussed above. In repetitive method the learner tries to master the material either part by part or the whole without understanding the meaning of the material and without understanding the relationship of each part with the other. So the learning becomes simply rote learning and *discrete learning*. This type of memorizing is not only short lived but also inefficient. On the other hand the facilities of meaning and broad relationship are found in the whole method of learning. Here the learner not only learns the meaning of the entire material but also the broad relationship among the parts of the material to be learnt and hence the whole method facilitates good memorizing.

(d) **Factor of consolidation through rest** : This factor is certainly in favour of spaced learning. Merely reading the material repeatedly without rest, apt to cause fatigue of the mind and makes it unresponsive. Repetition without rest kills interest and the motive to learn. These in turn make learning inefficient, slow and memory to be poor and vague. In order to restore interest and motive to learn, rest pause is very essential. This facility is found in spaced method. So adaptation of spaced method not only sustain interest and rejuvenates motivation to learn but also helps to consolidate and fix the memory traces caused by learning more permanently than otherwise.

Thus the above four factors discussed so far contribute much to efficient learning and better remembering.

### STAGES OF MEMORY

We have a notion that memory is a single process but analysis of it reveals involvement of three different activities, such as (1) Learning or memorizing (2) Retention, (3) Remembering. Remembering may be recalling, recognizing, relearning or restructuring. Now we shall deal with each of these processes separately.

## LEARNING

Learning or memorizing is the first stage of memory. To remember a poem or a passage : the first thing to be done is to *learn* or to get it byheart. Learning may be either by conditioning, imitation, trial and error or by insightful method. Whatever be the type of learning, we must pay attention to what we learn and must have intention to learn. We have to understand the meaning of the material and use it often, so that we will remember it better and longer.

As said already a good memory depends upon efficient method of learning. From the studies in this line psychologists have suggested some *efficient methods* of learning which are also known as *efficient methods* of memorizing. They are called economical methods because they save time, energy, and effort and at the same time makes learning and memory efficient. Some of the economical methods are : (1) Learning by understanding the meaning. (2) Spaced vs- Unspaced method of learning (3) Part vs Whole method of learning, (4) Repetition vs Recall method of learning, (5) The will to learn and remember. Though all these methods are considered as economical methods, how efficient, effective and economical they are, cannot be said definitely. They are not economical under all conditions and for all individuals. The efficiency depends upon the individual learner, his age, level of intelligence, nature and length of the material and the time at his disposal.

### (1) Learning by understanding the meaning :

Anything learnt by understanding the meaning of the material, lasts longer in the mind. On the other hand material learnt without understanding the meaning will be forgotten soon. In order to understand the meaning we have to read the whole material. Reading the whole material not only provides us the meaning of the material but also the significance and relation of each line or each part with the other parts of the whole material. By this the process of memorizing becomes really more intense and more pointed. The attempt to find out the meaning and its significance, brings into play greater amount of intellectual energy and con-

centration, than merely learning it without understanding the material. This can be demonstrated by a simple experiment. Take two matched groups of subjects whose intelligence, learning and memory are equal. Give a poem to both the groups, instruct one group to learn the poem by understanding the meaning and relation and another group to learn it without understanding the meaning and significance of the material. At the end check up their amount of learning, you will really find surprising results in favour of meaningful learning.

In this connection an interesting study has been made. The investigator has selected four types of materials with increase in meaning from material to material. Each type of material had 200 units. The Ss were instructed to learn each type of material one by one as fast as possible. The time taken to learn each type of material was recorded. Following are the results obtained from the above studies.

**Materials with the order of increase in meaning and ease**      **Minutes taken to learn 398 units of each material**

1. Nonsense syllables	93	Minutes
2. Digits	85	"
3. Words (Prose material)	24	"
4. Words (Poetry material)	10	"

from the above result it is clear that (1) how learning meaningful material saves more and (2) the increase in meaning and significance saves more and more time and energy.

Practical application of the principle of looking for meaning and pattern in the material to be learned has been reported by Stagner and Karwaski (1952). According to them the students who study for an essay type of examination do equally well both for essay type of questions and objective type of questions. Whereas students who prepare for objective type of questions do well only for objective type of questions and are handicapped if essay type of questions are given. This is so because the individual who prepares for essay type looks for meaning and pattern, whereas the student who prepares for objective type chiefly looks for specific facts.

## (2) Spaced vs Unspaced Learning :

When the material to be learnt is large, should an individual try to master the material at one continuous sitting ? or should he distribute his practice over a period of time with intervals of rest or other activity ? are the questions confronting us. Memorizing the material at one continuous sitting is known as unspaced or massed practice. On the other hand learning the material spread over a period of time or learning with intervals is known as spaced or distributed practice. Quite a few studies have been made to prove which one of the two methods is more economical. Some of them are in favour of massed method and some are in favour of distributed method. However a large number of studies are in favour of spaced method, provided there is a lot of time at the disposal of the learner.

In one of the studies made by C. I. Hoveland, two groups of matched subjects were selected. One is controlled group and another is experimental group. In order to hold familiarity of the material constant, a list of 12 nonsense syllables were used. 1. The controlled group of subjects were asked to learn the list continuously without a break. 2. Whereas the experimental group was asked to learn by the distributed practice. The material was presented through memory drum to hold the rate of exposure and the length of the exposure period constant. For the "controlled group" each trial was immediately followed by the next. For the experimental group each trial was followed by a rest period of two minutes during which they were asked to do some other simple and easy tasks.

From the above study it is found that (1) the controlled group which had adopted massed method took on the average, 15 trials to learn 12 nonsense syllables. (2) The experimental group which had adopted distributed method, took on the average 12 trials. Thus there is a saving of 3 trials to learn by distributed method.

Though the distributed method is advantageous, in actual practice the interval between the trials should be carefully regulated. (1) If the interval is too short or too long the method loses its efficiency (2) The use of this method also

depends upon the nature of the material to be learnt. Highly meaningful material needs no spaced practice. Spaced method is advantageous for learning long and difficult material.

In order to show how distributed practice is advantageous psychologists have offered a few explanations. Some of them are (1) rest pause between trials helps consolidation and fixation of memory traces. In the sense, the learning process which is set in motion, continues below the threshold of awareness for sometime. The memory traces caused by learning will have to be consolidated and fixed. So the time required for these activities is available in the distributed method. (2) Learning a long material at one continuous sitting, causes fatigue and this in turn resists learning. So rest pause available in distributed learning, reduces fatigue and the learner, continues to learn with fresh vigour. (3) Continuous sitting for a very long time reduces the initial motivation to learn. Consequently enthusiasm is bound to deteriorate with time. Thus in turn affects the concentration of attention and speed of learning. So the rest pause after each trial fills in new vigour and maintains enthusiasm. (4) The factors like interference and retroactive and proactive inhibitions have less effects. (5) Another important factor which is in favour of rest period is, that during the rest period the errors will be dropped out for want of reinforcement. So forgetting of the incorrect one's does not take place without rest pause. Further the correct ones become strong and fixed if rest pause is provided.

So the students who generally resort to massed method at the time of examination, should bear in mind *that slow and steady wins the race*. This principle is involved in the distributed method.

In another study (a) different length of work periods, (b) different length of rest periods and (c) different combinations of work and rest periods are studied, by using pursuit roter apparatus. From this study it is found (1) 10 seconds work period with 10 sec. rest period is better. (2) 10 sec work with 30 sec rest is best (3) amount of work is more significant variable than rest period, (4) efficiency also varies with the rest period. However from the other studies it is

found, (5) that most effective work unit, and rest unit depends upon the nature of the task and the S.

In spite of all these advantages in favour of spaced learning, massed method is advantageous if the time to learn is very short and the material to be learned is also short one.

### (3) Parts vs Whole Method of Learning :

Now the question is, whether it is better to learn a lesson as one whole unit or to divide it into smaller units and learn each part separately. The answer is rather a controversial issue because some studies are in favour of part method and some are in favour of whole method of learning. But the whole method has an edge over part method. (1) However the efficiency of any one of these methods depends upon the length of the material to be learnt, the age and the level of intelligence of the learner. (2) Young children learn faster with the part method if the material is comparatively short (3) If the material to be learned is too long, dividing it into smaller units is necessary even for the adults. (4) If the assignment is neither too long nor too short the whole method in general is better. (5) Generally individuals of normal intelligence and slightly below normal find part method easy to learn. (6) Bright children find whole method definitely advantageous to them.

In this connection R. S. Woodworth (1938) quotes an interesting study in his book. A subject was asked to memorize two passages of 240 lines each from the same poem (This is to keep the level of difficulty constant). The subject was asked to learn one passage by the whole method and the other by the part method. He was allowed to spend 35 minutes to study each day. The following results are obtained from his study.

Method of study	No. of days required	Total no. of minutes required
1. Thirty lines memorized per day : then whole was reviewed till it could be recited.	12	481
2. These readings of the whole per day till it could be recited	10	348

From the above results it is clear— (1) That the whole method is superior to the part method when we consider both the number of days and minutes saved to learn the material of equal length and of equal difficulty. (2) Only when the whole method is adopted the material becomes meaningful and its significance can be grasped. (3) Dividing the material into parts sometimes spoils the general meaning and continuity of thought. So, if division of assignment into small units is necessary, care must be taken to maintain the significance of each unit and meaningful whole. (4) When the material is too long it is better to divide it into parts of meaningful and self-contained units. Otherwise the subject becomes discouraged and loses confidence because the results are slow and poor. (5) The whole method does not provide the knowledge of results at each stage and hence he loses confidence. Naturally it affects adversely the efficiency of learning. (6) From this point of view, parts are easier to learn and learning of each part, fills in confidence and enthusiasm in the learner. He feels happy and better adjusted to the task if he begins with the part. (7) But he has to do the additional work of putting the learnt parts together into coherent whole. This naturally takes away the time and energy saved by learning the parts. In practical situation when the individual wants to learn part by part to save time : it is better to read the whole assignment now and then, so that the meaning of the assignment will be kept in mind. This makes learning quicker and more economical. Another way of combining part and whole methods to make learning economical is to learn part one, then part two and then learn parts one and two. Then learn part three and then learn parts one, two, three and so on. This combination of part and whole methods not only helps to save time and energy but also helps to maintain continuity of thought and meaning of the whole.

#### (4) Repetition Vs Recitation method :

Some bright individuals are able to learn and remember a particular material by reading it once or twice. Such people will have a very strong capacity, for visual imagery or some

special ability, or quick grasping of the material. But such cases are very rare. Whereas a good majority of the individuals will have to repeat reading to learn. So repetition is a necessity to learn an assignment. From the point of view of permanence of retention, the more we repeat, the better it is. Even after mastering the assignment, it is advantageous to repeat the lessons for a few more times. Such extra repetition is usually called over learning. This gradually reduces forgetting by protecting the memory traces from fading out. This is a very useful hint to the average student. Though overlearning is useful and beneficial, beyond certain limits it is not much advantageous because it does not yield proportionate benefits, and it becomes uneconomical. Example, suppose you require 10 trials to learn a list of nonsense syllables, then if you read it 15 times your retention will be better than reading it only 10 times. With this principle in mind if you read the same material 20 times the benefit will not be proportional to the effort.

Recitation or Reviewing is found to be advantageous for learning to progress and memory to be long lasting. So it is desirable to encourage the learner to recite or review to himself whatever he learns. It is proved experimentally that recitation is a boon to learning, whether the learner is a child or an adult, and whether the material to be learnt is sense or nonsense variety. The reasons for recitation to be better are 1) Recitation after each reading, provides the knowledge of results, i.e., how much is learnt and how much is remaining to be learnt. (2) When you know, how much is remaining to be learnt, you pay attention only to that and thus save time and energy. (3) The knowledge, of how much you have learnt fills in confidence in you and makes learning more efficient. The factor of confidence is already discussed. 4) By reviewing, you will be engaging yourself actively in learning. This active participation ensures more concentration of attention. Naturally learning progresses rapidly and becomes more efficient. 5) By reciting after each successive trial, you will develop interest in what you learn. The amount of material you have learnt in each trial, motivates you to learn more. Consequently your learning not only becomes efficient but also lasts longer. 6) By reciting

after each trial you are practising a sort of reproduction. which is the aim of every learning.

In order to show the advantage of repetition and recitation A. I. Gates has made an interesting study. He for his study selected grade school children and university students. They were asked to learn a list of 16 nonsense syllables and five short biographies, having 170 words in total. In all cases the total time spent for study was equal. The table given below shows the time spent for mere reading and time spent for recitation.

	Material studied 16 nonsense syllables percent remembered	5 short biographies having 170 words in total. percent remembered	Immedi- ately	After 4 hrs	Immedi- ately	After 4 hrs
1) All time spent for reading	35%	15%	35%	35%	15%	15%
2) 1/5 of time spent for recitation	50%	26%	37%	37%	19%	19%
3) 2/5 time spent for recitation	54%	28%	41%	41%	25%	25%
4) 3/5 time spent for recitation	57%	37%	42%	42%	26%	26%
5) 4/5 time spent for recitation	74%	48%	42%	42%	26%	26%

From the table it is clear : (1) whether the material is nonsense syllables or meaningful one, recitation is better than mere reading, (2) recitation is more advantageous for nonsense syllables than meaningful material, (3) spending more time for recitation is better than spending less time. The benefit from recitation is proportional to the amount of time spent for recitation while learning (within certain limits), (4) whether it is short term recall or long term recall recitation has its own value over mere reading. The superiority of recitation over simple reading seems to lie in the more active attitude it involves and greater degree of behavioural organisation that ensues from the attitude (Gates)

#### (5) The will to learn and the will to remember :

All the methods discussed so far will have their effect on

Learning only when there is a desire on the part of the learner to learn the material. Along with the *will to learn* there must also be *will to remember*. This "will to learn and will to remember" can be made clear from the example of the students who take examination. All the students will have intention to learn and remember, so that they can write well in the examination. Naturally they do well in the examination but soon after it, they forget almost everything they have learnt. This is so because they will have no intention to remember permanently. Similarly many read newspaper daily in the morning but they remember only the details of the items they like and the rest will be forgotten soon. This should be borne in mind by the students.

In one of the studies, a teacher used to present orally a list of 12 words, in two terms in a year. In each term he was presenting the list five times. Thus he had presented the list for many years. Each year the students were expected to learn and reproduce the list correctly. Every year the students were able to reproduce the list after listening 3 or 4 times, whereas the teacher was not able to remember even a single word, though he was presenting it for several years regularly. This was so because he had neither intention to learn nor to remember.

In intentional learning, motivation and active participation are kept at high level. These two things make learning efficient. Another subjective factor related to motivation, affecting learning and recall is one's attitudes and bias towards the content of the material to be learned.

Thus psychologists have suggested various efficient and economical methods, but all of them are not useful to all and at all times. The relative advantages depend upon the material, learner, time at his disposal, age and intelligence etc.

## RETENTION

Retention is nothing but retaining the thing we have learnt or the experience we had in the past. Only when the thing learnt is retained we are able to make progress in our learning, otherwise we have to learn the same material again and again and we will have no time to learn anything anew. Apart from

this our adjustment to the old as well as to new situations becomes a problem. So retention plays a significant role in the progress of learning and achievements in life. Whatever we learn will be retained in our unconscious and comes to our consciousness only when it is required. This unconscious is like an ocean, wherein all the experiences forgotten as well as remembered are stored in. According to some psychologists, the learner will be reciting within himself continuously in his unconscious, and hence it comes to consciousness when required.

According to this author, experiences which contribute to restoration of mental homeostasis will be retained in the nerve cells and the one which disturbs homeostasis will generally be erased, or inhibited, because they disturb mental homeostasis.

According to some other psychologists, whatever we learn or experience in our daily life, cause *memory traces*. These memory traces are known as *neurograms* or *engrams*. The engrams are the modifications in the nerve cells, analogous to the molecular changes in a magnetic tape, which allows us to playback what was recorded. These structural changes, though inactive, persist, until they are aroused by some effective stimulus. This explanation does not stand the test of verification.

According to some other theory, the engrams go beyond *neuroanatomy to biochemistry of the nerve cells*. This is known as *molecular theory of memory*. According to this theory, memory storage depends upon RNA(Ribonucleic Acid) metabolism. The RNA molecules, like any other molecules, are important constituents of the nervous system. Their structural and functional states change dramatically during learning experiences but they do not function as permanent memory traces. Another explanation is that, RNA molecules, have a unique role in the nervous system, and serve as final engrams of memory. These engrams are the permanent memory traces. According to an eminent neurologist, the human brain is composed of 10 billion nerve cells which interact in various ways. Each cell contributes to behaviour and presumably to mental activity by firing impulses or by failing to fire

impulses. What we call as memory, can be explained in terms of the temporal and spatial patterns of these discharges. Forgetting is due to the obliteration of these memory traces or rendering them ineffective by something which interferes with its expression.

It is found from the studies that factors which affect learning also affect retention. Accordingly, (1) learning of meaningful material or learning the material by understanding the meaning, will be retained longer than the meaningless material, (2) larger is the material to be learned, causes retention to be longer because the learner will be, active, attentive, and puts forth more effort to learn it throughout. Naturally retention of such learning lasts longer, (3) the material which is unpleasant, and uninteresting will be forgotten soon; because of repression. Whereas the material learned or the experience gained is pleasant, will be retained longer. For example : In a study, a group of students soon after Christmas holidays, were asked to write down separately pleasant as well as unpleasant experiences they had during Christmas holidays. Thus the number of pleasant and unpleasant experiences were collected from each student. Again after six weeks, surprisingly, the same students were asked to write down the pleasant and unpleasant experiences they had during Christmas holidays. This data was also collected from each student and compared with the previous data. It is found from the study that, (a) The students on the average had reproduced second time, only 53% of the pleasant and 40% of the unpleasant experiences, of those written earlier. This makes clear that the unpleasant experiences will be forgotten more than the pleasant experiences. (4) Retention is better with the fast learner than with the slow learner. (5) Retention for the incomplete task will be greater than the completed tasks (Zigarnic). (6) There are age differences and individual differences in retention. Thus retention depends upon various subjective and objective factors.

**Perseveration :** No mental activity either begins or ends abruptly. Even though the stimulus which sets the activity ceases, the activity thus provoked continues at the subterranean level for a certain length of time. Similarly the learning activity which sets into action by stimulation continues for

sometime even after the stimulation has ceased. This continuation is highly useful both for learning and retention. So we have to allow certain length of time for this subterranean activity to continue without interruption, to facilitate the memory traces : which are in the process of formation to assume a definite shape and to get fixed up. instead of allowing time for this activity, if some other activity is started immediately it affects retention adversely. Consequently the memory traces become vague and retention becomes poor. Thus perseveration is highly correlated with retention.

### **Fixation and Consolidation**

Soon after the activity of learning is over, the process of *Fixation and Consolidation* begin in our subconscious mind. Consequently the material learned sinks into brain and assumes a definite and permanent form. This requires some rest pause, to the mind. So to provide the rest required, the learner should sleep or relax for a certain length of time. This period is technically known as *Incubation period*. Instead of allowing rest pause required for fixation and consolidation of memory traces, if the learner exerts himself with some other learning or with strenuous activity of some kind it interferes with the process of fixation and consolidation. Naturally retention becomes vague or poor. Even an injury or shock to the brain destroys or distrubs the memory traces. So retention to a large extent depends upon fixation and consolidation of the memory traces initiated by learning.

### **Methods of measuring retention**

Psychologists have developed certain methods of measuring the amount of material retained after learning. Some of the methods commonly used are : 1) Recall method, 2) Recognition method, 3) Relearning method and 4) Reconstruction method.

#### **1. Recall Method**

Recalling is nothing but reproducing the material already learnt, in its absence. While recalling, the material learnt will not be present. As we have to reproduce the material in recall

ing, it is known as the *method of reproduction*. Recalling or reproduction is possible only if the material learnt is retained. So the amount of material recalled is an indication of the amount of retention. Though recalling is one of the methods of measuring retention, it is not an accurate measure, because recalling does not bring out all that is retained. We retain much more than what we recall or reproduce, at a particular time. Quite a good amount of material learnt exists below the threshold of recalling. This can be demonstrated by other methods. So, the method of recall is not an accurate measure of retention.

Sometime we do experience, the failure to recall the name of our best friend or fail to recall our own date of birth. The more we try to recall, the more we fail to do so. If we give up our attempt and keep quiet, sometime later we recall them automatically. Sometime we recall partly correct and partly wrong. Sometime we totally forget them. Thus we come across various set backs under recall memory.

Without retention there cannot be any recall, but there can be retention without recall. Failure to recall though the retention is intact is known as *recall amnesia*. Here amnesia is used to mean loss of memory. On the other hand failure to recall because of poor retention is known as *retention amnesia*. Of the two types of amnesia, recall amnesia takes place due to blocking or interference in the process of recalling. This blocking or interference is caused by *emotional disturbances* like fear, anxiety, worry and self-consciousness. For example : Stage fright, interview, examination etc, during which emotional blocking takes place. This can be overcome gradually by gaining confidence and by developing an attitude of indifference to the particular situation. Another reason for failure to recall is *associative interference*. According to this, while recalling something, some other experiences of the past related to it will interfere. Then there will be a conflict between this line of association and the one which leads to the correct answer. This conflict makes the required recalling difficult and impossible. So when there is associative interference, it is better to give up the effort to recall for sometime. Sometimes our recalling depends upon our set or

*attitude.* Unless there is interference, the set or attitude makes recall easier. The *will to recall* is important and hence attention should be directed towards details relevant to the fact wanted.

In order to study-recall, several experiments are conducted both on children and adults. Some of them are : (1) In one of the experiments, an infant was presented with a ball containing chicken. When the ball was squeezed, the chicken used to pop out of the hole. After a number of trials of demonstration, the ball with chicken was taken away and some other activity was introduced as distraction. After a few minutes of interval another ball without the chicken was provided to the infant. When it was squeezed the chicken did not pop out. The investigator was able to observe the presence of recall from infants activities, such as the infant expressed surprise at it, looked at the experimenter, questioningly looked into the hole of the ball, inserted its finger into the hole to search for the chicken etc. From this study, it was concluded that (a) the maximum interval of time the child could recall the chicken was three minutes at fifteen months, and seventeen minutes at two years of age, (b) between two to five years of age there is an increase in the interval of time after which it could recall, (c) recall in older children and adults occur even after years, (d) language seems to play a very important role in reinforcing the symbolic process present in infants.

(2) Another way of studying recall is by *recalling paired associates*. Here the S will be presented a list of paired words at a particular speed. He has to learn to recall one of the paired word, when the other one of the same pair is presented. Example : Skill-Watch, Man-College, etc. After the presentation of the list first time, the "E", presents only one word in each pair and the "S" has to recall the associated word. Thus list will be presented until the S recalls the whole list. If the number of words recalled in each trial are plotted on a graph, it yields learning curve.

(3) *Recalling narratives* is another way of studying recall. In one of the studies, an University student was instructed to read a story twice and then to engage in some other activity

for fifteen minutes. Then he was asked to reproduce the story. The story runs thus : "the story of a son who tried to outwit his father". "Son told his father that when he hides, his father will not be in a position to trace him. Father replied, "you hide anywhere and I will trace you out." So saying he went to rest in his house. Then the son changed into a peanut. It was eaten by a fowl. A wild bush cat caught and ate the fowl. A dog ate the bush cat and that was swallowed by python. The python, which went to a river was caught in a fish trap. Father searched for his son went to fish trap, killed the python, and traced his son. The son wondered and never again tried to outwit his father."

After reading the story once the S was asked to recall it again and again. An analysis of the result reveal—(a) Accuracy of reproduction is a rare exception, (b) Outline continues to be there when once it is presented, (c) Style, rhythm and precision are rarely reproduced, (d) Omission of details, simplification of the events, structure and transformation of items into familiar details continue indefinitely, (e) In remembering after a long lapse of time elaboration is very common. Thus there will be a lot of distortions in the reproduction of the items learnt

4) The other way of recalling is *reproducing* forms shown. Here the S will be shown some pictures once and will be asked to reproduce the same pictures repeatedly after a lapse of time. Here also we find lots of distortion as in recalling of narratives.

5) Another common way of studying recalling is recalling of nonsense syllables, meaningful words, digits etc, after a single presentation. This is known as "*memory span*". Memory span varies with age, duration of exposure, familiarity of meaning of the material, practice etc. It is found from the studies that (a) the average recall of auditory presentation is of the 4 digits between 4 and 5 years of age, (b) 5 digits materials between 6 to 8 years, and (c) 7 digits beyond twelve years. Thus there are several ways of measuring by recall methods.

## 2. Method of recognition :

Recognition method is another quantitative measure of *remembering and forgetting*

tion. Here the S is required to recognise the original items from among the new items of the same class or category with which they are mixed up. Though it is closely related to recall it is different from it. in the sense, in recall memory, the items learnt will not be present at the time of recalling, whereas in recognition memory the items learnt will be present right before the S, but mixed with new items. The task of the S is to identify the familiar ones. which are mixed with the unfamiliar,

Recognition appears to be a passive process at the outset, but in reality it is active process, because of the following reasons : (a) during the process of recognition, the activities connected with perceptual process come into operation, b) we tend to look for some particular thing c) we tend to see what we want. d) we tend to put out ourselves with a particular attitude, and e) during the process of recognition, a considerable amount of organising activity, as under perceptual process is found.

In order to study recognition under laboratory conditions, a set of pictures, or situations, or nonsense syllables or words ; will be shown to the 'S' for a period of 15 seconds. After an interval of time, these items will be mixed up with new items and the S is required to recognise the familiar items from among the unfamiliar ones. Now if we carefully analyse the introspective data of the S under recognition memory we find that (a) We tune ourselves in relevant way that would help us to recognise the one seen before, (b) We recall the necessary images mentally, to recognise the required object, c) Sometimes hesitation occur ; in our mind. This shows that it is not an easy and passive process, d) Sometimes the unfamiliar looks familiar and sometimes the familiar one looks unfamiliar e) sometime we recognise the familiar items in terms of *reduced cues* All these go to show how recognition is very active process.

In recognition we commit two types of errors—a) failing to recognise the familiar or old ones and b) mistaking the unfamiliar as familiar one, due to similarity. On the other hand, if there is dissimilarity between the familiar and unfamiliar recognition becomes easy. The item which is learnt well or experienced well can be recognised easily. Sometimes recall

come to the help of recognition and makes it complete.

If we take the reaction time into account, the correct responses are quicker and more confident than the wrong ones. The response to the new and similar one is not decisive, whereas the response to the new but dissimilar is quick and decisive.

In a study a group of 50 boys aged 18 years and 50 girls aged 17 years were shown a set of 12 pictures. Then the pictures were withdrawn, mixed up with 12 similar pictures and presented the whole lot for recognition of the familiar ones. Following are the results obtained from the above study.

From the table below it is clear that a) Boys have recognised more number of photographs than girls, and recognition memory is slightly better with boys than with girls, (b) Maximum number of boys have recognised 7 photos correctly, whereas maximum number of girls have recognised only 6 photos, (c) Maximum number of photographs are recognised by more number of boys than girls, (d) Though the Ss. recognised most of the pictures correctly, still some errors are found in recognition memory. Those errors are due to failure to recognise the old ones and recognising the new and similar ones as old ones.

Total No. of Pictures correctly recognised	50 boys		50 Girls	
	Frequ- ency	Percent	Freq- ency	Percent
3	—	—	1	2
4	1	2	9	18
5	5	10	14	28
6	11	22	15	30
7	20	40	9	18
8	13	26	2	4
Average No. of Pictures correctly recognised	6.5		5.6	
Max. recognised correctly	8		8	
Min. recognised correctly	4		3	
Range	4		5	

Just as perceptual process is directed and determined by inner motives and prejudices, recognition is also guided by our deeper emotional prejudices. In this connection it is interesting to note the work of V. Seeleman. He presented to his Ss, pictures of Negroes and white students for recognition. Some subjects were favourably disposed towards negroes and some were unfavourably disposed towards negroes. From this study it is clear- (a) The favourably disposed towards negroes have recognised more number of negro photographs than those who were unfavourably disposed towards negroes. (b) This reveals that motives and emotional prejudices play an important role in directing the process of recognition. (c) It is also clear from the study that pleasant experiences are remembered more than the unpleasant ones. In general it may be concluded that the method of recognition almost always yields a higher score than that of recall. We can recognise many more items than what we can recall unaided.

### 3. The Method of Relearning

This is also known as *method of saving*. This is the most sensitive of all measures of retention. We call it saving method because we measure retention in terms of gain or saving in the number of repetitions or in the time required to relearn the assignment. Difference between the amount of time or trials required for original learning and the one required for relearning is called "*absolute saving score*". Sometimes the savings score is given as a percentage of the original learning score *relative saving score*. This indicates the amount of retention of what is learnt. In other words it indicates how much is forgotten and how much is retained.

Sometimes it so happens, that what we have learnt six months ago or a year ago is either partially recalled or nothing is recalled. This does not mean that nothing is retained. Something will be retained definitely but it may not be evidenced either through recall or recognition. This can be evidenced through relearning. Suppose we had taken 20 trials to learn the lesson during first time. we relearn the same lesson, second time in 10 trials. So there is a saving of 50% of the trials by relearning. This indicates retention of 50% of the

material learnt originally. Thus relearning provides a good measure of retention.

#### 4. The method of Reconstruction or Rearrangement

Though the method of reconstruction is similar to the method of recognition, it is different from it in certain respects. In the method of recognition, the S has to identify the ones seen already from among the seen and unseen items mixed up. In the 'method of reconstruction the emphasis is placed on remembering the spatial and temporal order in which the stimuli to be learned were originally exposed. Here the material to be learned will be presented in a particular order, and then the items will be jumbled up or shuffled thoroughly, and presented to the S instructing him to rearrange them in the original order in which it was presented. Here we find two processes being involved ; (a) identifying the items seen and (b) arranging them in the original order. The score is the number of items recognised and rearranged in the original order. This indicates the amount of retention.

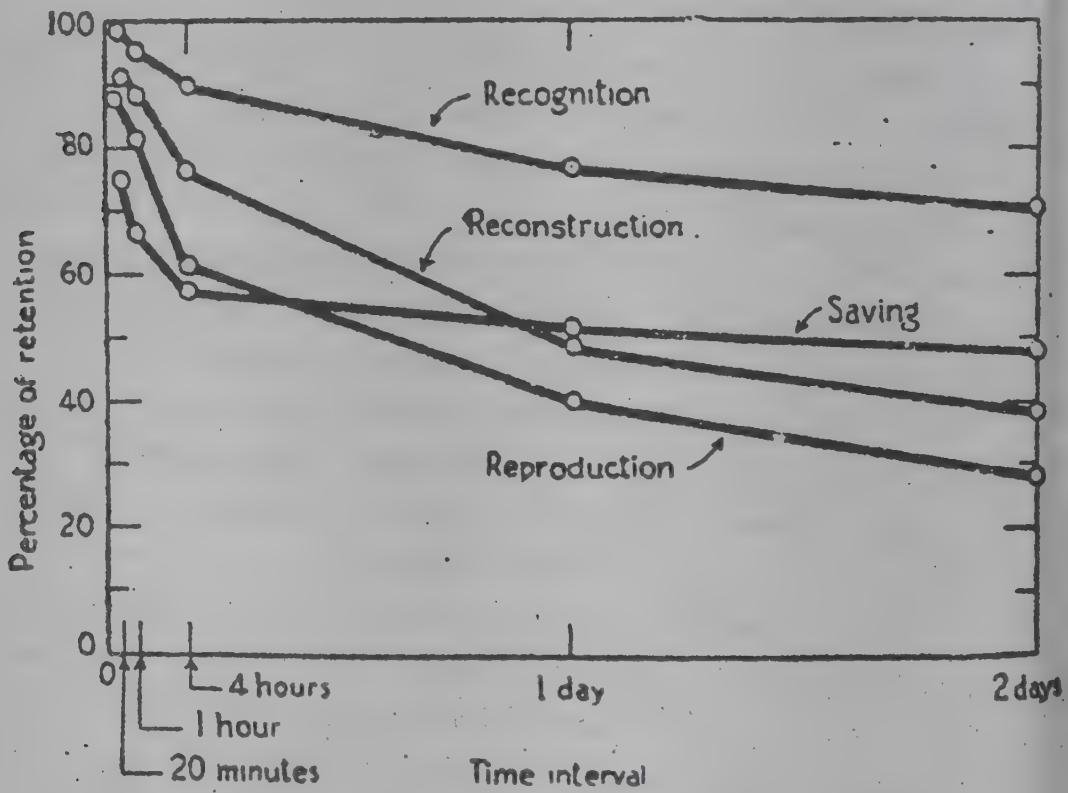


Fig 20. Curves of retention obtained by four different methods

So far we have learnt the different methods of measuring retention. In one of the studies, relative efficiency of each method is determined. A student was asked to learn perfectly

12 non-sense syllables. Then after 20 minutes, one hour, four hours, twenty four hours, and 48 hours, his retention was measured by all the four methods. The results obtained from each method, after each interval of time mentioned above are plotted on a graph.

A glance at the graph reveals (a) the method of recognition gives much greater amount of retention than the method of recall, (b) recall gives least amount of retention and (c) the method of reconstruction and saving are moderate. It is also clear from the graph, that the four techniques when used on identical materials are not of equal sensitivity.

### TYPES OF MEMORY

Memory-means to be mindful, or to remember. Memory is the store house of past experiences. Thus it is the seat of our ability to recreate or reproduce past perception, emotions, thoughts and actions. To be truthful, we have only the vaguest notions of how our memory actually works (McConnell (424)

There are three distinct "Types of Memory", through which the information we get from the environment passes on. The "*control process*" determines what information has to pass on from stage to stage and what can be remembered later on. Every stimulation which reaches the receptors resides with great richness, but only for a brief period. This shortest duration of retention and remembering is known as "*sensory Memory*". The duration of this period varies from one sensory system to another but it is not more than 3 to 4 seconds for any sensory system. Within this period most of the information in sensory-memory fade away but only some information passes on to *short term memory*. The control process which determines the information, is subjected to "*attention*".

Compared to sensory memory and its momentary holding of vast information, the storage capacity of "*short-term memory*" is very small. The duration of short-term memory is 15 to 20 seconds and the storage capacity is about  $7 \pm 2$  items; letters or numbers. During this brief period of existence in short-term memory, some of the information will be "*rehearsed*". The important part of this code is auditory or acoustic in nature.

The information which reaches "long term" memory may stay there for a long period or permanently. - The information will be stored in terms of meaning and association, and will be available for retrieval when required. Here the acoustic information plays a key role in retrieval of verbal material.

### (1) Sensory Memory

Every moment we are exposed to, some stimuli or the other. Consequently our receptors in the respective sense organs are stimulated and they will have the impressions of those stimuli. Thus stimulations are attended, received, retained for a brief period, and transmitted to higher brain centre or centres to take necessary action or to be stored in for future purposes. Thus our memory begins in our receptors. This is the first stage of "memory storage". When we are watching the blank screen of television, if a word *truth* appears suddenly just  $1/10$  of a second and disappears, rods and cones in our retina will hold the image of the word "TRUTH" for much more than a second. During this "holding stage" the rods and cones continue to send signals to the brain as if the word is still there on the screen. This "momentary holding" of incoming sensory stimulus (image) is known as "sensory memory". This sensory-memory lasts only, one or two seconds and then fades away. This disappearance of most of the materials from memory is necessary because the individual's processing capacity is very much limited. It is also necessary to have some mechanism to select the information which is to be retained. Infact this purpose will be served by attention and the information retained beyond 2 seconds enters into short-term memory.

### Short-term Memory : (primary memory)

As said above, we experience millions of varied sensory inputs everyday. Only a fraction of incoming messages are passed on to the brain from sensory-memory stage. Some part of the brain remembers them for a few seconds (less than a minute). If the messages are uninteresting and unimportant they are forgotten soon. It is found from the studies, that we can hold  $7 \pm 2$  items at a time in short-term memory. Our brain stores verbal description of the input in our short-term

memory. (James V. McConnell- pp. 424-426). This information lasts only for a few seconds i, e. about a minute. When the shortterm memory is holding the verbal description of the stimulus for a few seconds, the rest of our brain decides how best to respond to stimulus. When this activity is going on much of the details of the sensory information will be lost in the storage process itself.

The moment our brain inserts new item, it appears to remain strong, clear, and easy to recall immediately. Soon our brain goes to adding item by item. These new items, for want of space and survival, either interfere with or erase the items which are in front of them (old ones). It is said (Mc Connell) that retention of letters or numbers with meaningless combinations, decline gradually in eighteen seconds. The span of short-term memory is the same for both letters and numbers. Based in this, registration numbers of automobiles are limited to three letters and four numbers. One can see these limited number of items at a glance and can remember for a few seconds. The items held in short-term memory can be recalled or rehearsed immediately "at will" because of the factors of primacy and recency. The items dropped out at the temporary stage, are likely to disappear for ever, unless our brain decides to make a "permanent record" of the stimulus based upon the principles of grouping and organisation, and meaningful combination of them.

### **Long-term memory : (Secondary Memory)**

Long-term memory is the store-house of permanent memory. The information which is important enough to survive, will be transferred from short-term memory to long term memory by some physiological mechanism, which is yet to be understood. We store the items in long-term memory in terms of "mental categories", (with some descriptions). When once an item is put into long term memory, it will be available, if we know how to retrieve it.

Long term memory lasts for ever. It's storage capacity is unlimited, Billions of different memories, from the early childhood are buried in our brain cells. It is like a huge library with billions of books stacked away on the shelves.

Though everyday thousands of new volumes are added, still there is space for new additions. It is said that not even the largest and most advanced system of computer now in operation can match the complexity of human brains memory bank (Mc Connell. P. 428). Thus every information (input) coming through every sense organ and transferred from short-term memory to a more permanent-memory are encoded in the form of engrams and preserved by categorisation. (Gregory. A. Kimble etc. pp. 179-181), By appropriate stimuli and favourable circumstances one can go back and reproduce all those countless experiences. Some can be recalled "at will" with less effort, some with more effort and some by special techniques, such as free association hypnosis and dream analysis.

### Stage 1

**Dual-Coding Theory** : According to this theory, the information is stored in long-term memory by two separate but interconnected systems or codes. They are - (1) a "system of visual images, and (2) a verbal or semantic system" The system of visual images handles only concrete, spatial, imaginable objects and events. These items are coded in the form of pictures and stored in the brain. The verbal system handles abstract verbal units and structures. This adapts words and association to code the verbal information. Sometimes both the systems will be clubbed together to preserve the information or input. Information represented in both systems rather than in one system, can be recalled more easily. For example : concrete words i. e. words referring to concrete objects, things, animals etc, are coded both in the form of visual images and verbal form. Such informations can be " retrieved in any one form or both the forms easily. Evidences Indicate that concrete words, such as : Table, Man etc, can be served by both the systems. According to some of the studies, with time the materials are stored in long-term memory by changing the images into semantic codes.

**Episodic and Semantic Memory** : Endel Tulving (1972) differentiates between memory and knowledge. He classifies memories into two types- (1) Episodic memory and (2) Semantic memory. "Episodic memory" consists of personal experiences

i. e. autobiographical events, temporally dated. They are tied to "time and place." "Semantic memory" is nothing but organised knowledge about the world. It consists of facts, principles, relations, and strategies. The information is coded and stored in such a way, that it can be retrieved in a form different from the one in which it was originally stored. This semantic memory plays a very important role in retention.

**Organization of Memory:** Semantic memory has an organizational effect, which helps us to recall information. If the material lacks organization, the individual will invent an organization of his own. This "Subjective Organization" helps to recall the items in an order. For example : medicine, hospital, doctor, patient, recovery, treatment. Here we find no organization in the list of words. The individual who gets this unorganized information organizes, stores and retrieves in the following order : hospital, patient, doctor, medicine, treatment, recovery. We also find categorization of the items in storing and retrieving. For example :- table, red, chair, green, sugar, stool, water, salt, cot. Though these items are concrete meaningful words, they are not categorized in the presentation. This input will be categorized by the subject before storing them in the following order : categories (1) table, chair, stool, cot, (2) red, green (3) sugar, water, salt. This categorization is purely based upon personal experiences which helps to store and retrieve in an order.

**Context and Memory :** Memories of an individual are tied to a situation and time in which the experience occurred originally. This may be weak or very strong. For example, the recall of an experience is slightly better in the place where one has originally experienced than in a different setting. In the same way the individual will have at a particular point of time in the day will be tied to the time and hence the individual can recall it better at the time in which the experience he had originally, than at other times. This principle is the same as law of contiguity. In the same way laws of similarity and contrast, also operate in storing and retrieving of information.

**Retrieval :**

Retrieval in memory is the process whereby items to be

remembered are recalled (Gazzaniga, P. 300). It is the search through a region in memory where words with a particular range of meaning of an item, with particular physical features, are stored. Normally the physical features are acoustic in form. In the process of retrieval material from long-term memory re-enters into short-term memory. Even here the code is mostly acoustic. (Kimble, pp. 181-182). Items will be retrieved from long-term memory by checking out various "categories" under which the item might have been filled while storing. If right entry point (category) is not traced to retrieve the item, it will not be possible to remember it. This does not mean the item is not there but it is not accessible.

In order to facilitate "retrieval of information from memory" the original process adopted while storing the information will be directed to set up plans to serve the purpose in hand. If an item is coded as a member of a "chunk", it can be retrieved easily, provided the chunk is retrieved. If none of the items in a chunk is retrieved, then by supplying the chunk label, i.e., the name of the category, to which the item belongs, one can be helped to recall a large proportion of them (Vernon Gregg, pp. 90) Here Tulving, Pearlstone introduced two concepts viz *availability* and *accessibility* and draws a distinction between them. They say, that once the items are coded and stored in the memory they are "available" but they may not be "accessible to the efforts we put forth. Under such conditions "cues" make them accessible.

Mc Connell says (pp. 428) that when an item is presented either visually or auditorily, brain "files or stores" the item in long-term memory by preparing "*Mental index card*" of some kind, which aids to retrieve the item when needed. In the sense our brain translates our personal experience into a kind of mental short-hand and files them under various categories. We cannot recall the item unless we 'discover' to what category the item belongs. Sometimes there will be "cross references" between various categories.

In order to demonstrate the importance of "cues" in retrieving, Tulving and Pearlstone have made interesting studies. In one study they presented first, the name of the category follo-

wed by a few words. Then the name of another category followed by a few words. Thus he presented a list of words following the same procedure. This helps to code each word as an item of a particular category and not under other category. If a word "Bed" is presented to the (subject) S preceded by the category name "furniture" it will be coded differently than when it is preceded by the category name "Garden". Here the cue is effective in retrieving the words only when the words are stored according to the plan which involves cues.

Tulving conducted another two experiments to test the conditions under which "retrieval cues" are effective in aiding recall. The task was to remember a list of 24 unrelated words. He presented one word at a time, printed in capital letters on a small card. One group of Ss were given each word : with an additional word printed in small letters above the capital word Ex : green/"VEGETABLE". The S need not recall the word with small letters but it serves as a cue to remember the required word (capitals). The second group of Ss were given the capital lettered word without the accompaniment of small lettered word. Even this group has to remember the capital lettered word for recalling. The first group of Ss were divided into three subgroups 1) Subgroup "A" was given the "cue" to recall the word required. 2) Sub group "B" was not given any cue while recalling. 3) Sub group "C" was given cues which were different from the orginal cues given at the time of presentation. Ex : Leg/VEGETABLE. whereas the second groups of Ss were given no cue at the time of presentation but while recalling some were given cues used for other groups, and some were not given any cue while recalling. In short the Ss had either similar conditions of cueing or different conditions of cueing.

The results of the above study reveals that 1) Cues are helpful to retrieve if they are presented at both, input and output phases of the task. 2) Giving cues either only under input or output is detrimintal because recall is worse than no cues under both the conditions. Recall was at lowest level with the group which was given cue at the time of recall. From this it is clear that the plan to be executed must be constant and

consistent both at the level of storage and retrieval if retrieval is to be effective. Further from another study he found that a strong associate is more capable of cueing recall than a weak associate. Here strong associate word will have a definite relation with the word-to-be-recalled: For example: white/BLACK. Here the associated word "white" has exact opposite relation with the word-to-be-recalled "WHITE". In weak association the associated word will have no relation with the word-to-be recalled. Example : air/BLACK. Here the word "Air" is a weak associated word.

### Some Special Phenomena

(1) **Eidetic Imagery** : Remembering is not a property of any one individual or any one race, rather it is found in all individuals but it differs in degree or magnitude. In some it will be less and in some it will be more. In some, especially in children under six years of age, the testimony is so accurate, that it will be almost equal to actual situation. These exceptionally accurate *memory images* have been called *eidetic images*. It will have the clarity of *hallucination* but the person knows that it is only an image and not a percept. This is rarely present in older children and adults.

The most common test of eidetic imagery is to present a picture with many details for a few seconds. After removing the picture, ask the child to describe what he saw. The eidetic child seems to project the picture on any convenient surface and describes what he sees. A child with *acoustic eidetic imagery* will repeat a long list of digits after hearing them once.

**Idiot Savant or Wise Simpleton** : There are exceptionally very few people who have phenomenal memory with generally low level of intelligence. Such people are called *idiot savants*. These people are below normal in intellectual traits but have developed some trait to such an extent which makes them really exceptional. This person will have remarkable memory for events and can reproduce all the details of the object and event seen days or months or years ago. If that person is asked what was the day on January

1960, he will immediately tell you the day of week. Though his memory is remarkable he is not a genius, but an idiot.

3) **Reminiscence** : Improved retention after an interval of time has been called reminiscence. Better retention and recall of incompletely learned material, after a long time than immediately after learning is known as reminiscence. This is related to the phenomenon of better learning and retention by *distributed* than by *massed* practice. Also related to interrupted activities than completed activities (L. B. Ward, Munn. pp. 387). Another theory offered to account for reminiscence is *recovery from work* theory. According to this a continuous practice causes fatigue with learner and hence he cannot show all he has learnt. After resting the retention shows improvement. The degree of reminiscence is positively correlated with the length of the rest period. (Study by Irion. 1949, Whittkar, Psychology, p. 280).

4) **Dejvu** : Dejvu (french word) is a form of memory distortion in which the individual will have *illusion of having seen*. Sometimes an individual will have an odd experience of having a strong feeling of familiarity attached itself to an entirely novel situation. This happens to many people on many occasions. The reason for this is something in the present situation is identical with or very much like, something that occurred previously. This present aspect of the former stimulation leads to recall the original experience and we incorrectly identify it with the present one. According to Freud, Dejavu experience often arises in the actualization of fantasy-a day dream.

### How to Forget ?

In one's span of life, many pleasant as well as unpleasant events take place and it is natural, the pleasant experience makes the person happy whereas remembering of the unpleasant experience makes the person to be depressed and sorrowful. With the lapse of time the intensity of the unpleasant experience reduces and sometimes the experience will be forgotten, Until such time man has to struggle and suffer the agony of it. Because of a series of unpleasant events have happened to the poet John Keats, he prayed God to make his

heart as hard as stone and he often had expressed that he was envious of trees which are happy without any sorrow or misery in their lives. So our life becomes miserable if we do not forget such unpleasant painful experiences. But how to forget such unpleasant experiences is the question. The answer to this question psychologists have offered some useful suggestions which if followed help us to forget the unpleasant events. Some of the suggestions are as follows :

(a) Soon after the unpleasant event has occurred avoid recalling or reciting such events for a few days. It is easy to suggest but difficult to follow the suggestion. Especially, if these events are related to death or disappointment or failure in life it becomes very difficult to keep them out of mind. Under such conditions, it is better to leave the place of the event for a month and to engage in some interesting activities. If you have no time to worry or no time to recall the event, it will, gradually fade away from your memory. This is one of the main reasons why in olden days, if a person were to die in the house, the entire family used to vacate the house for 3 or 6 months and stay in some other house. Sometimes they used to celebrate the marriage of their daughter within one year from the date of death. This practice is in vogue with Hindus in some parts even today.

(b) Before you get sleep you are likely to recall because you will have time to do so. So the best thing to do is to have strenuous exercise before you go to bed, so that, you will be tired and fall asleep the moment you go to bed. This helps you to forget the unpleasant experience soon. Due to disuse such experience will be atrophied and forgotten.

(c) Time is the best remedy to forget any event. In reality mere lapse of time will not help to do away with it. A number of new events or experiences which take place during the period either interfere or inhibit the unpleasant experience and help to forget the unpleasant events.

(d) Do not allow time for perseveration and consolidation of the memory traces of unpleasant. This naturally helps you to forget the unwanted experience.

(e) Do not follow the principles of improving memory. These are the best ways to forget the unwanted.

If you follow these suggestions, you can forget anything you want.

### • FORGETTING

Our memory is not always pleasant or unpleasant. The unpleasant experiences may be due to the conflict between higher and lower motives or between higher and lower values of life. Such experiences are inevitable in one's span of life, because life is not a bed of roses and to sleep on it is not an achievement. Life must be lived through such odds. Though such things happen in one's span of life, they must be forgotten if living were to be made pleasant. Though we wish to forget the unpleasant and to remember the pleasant, they are not entirely in our hands. Such things in course of time, due to many reasons will be forgotten. This forgetting is of two types—(1) Normal forgetting and (2) Abnormal forgetting.

#### 1- Normal Forgetting :

Forgetting is not due to single cause or a simple reason. Many factors are involved in it and some are difficult to explain. At the outset forgetting seems to be either due to inadequate impression or no impression. Many a time we fail to remember a name or the news items read in the newspaper because we pay little attention to them. Inability to remember what has happened during an exciting or disturbing event is in fact due to inattention. This type of "memory loss" is known as "anterograde amnesia". In contrast, forgetting of things happened before the disturbing event is known as "retrograde amnesia". This should not be mistaken for "retroactive inhibition", which involves an interference by new learning with earlier learning. Experimental extinction under conditioning also resembles in certain ways forgetting. Even without emotional disturbance and extinction, the actual learning is forgotten either partly or wholly. Such forgetting is due to the following reasons :

(a) Passage of time : It is commonly assumed that lapse of time itself is responsible for forgetting. According to this the memory traces due to lack of use, gradually deteriorate,

or will be atrophied. For example :- the geometry, algebra and such other subjects learnt at higher secondary school are almost forgotten because of disuse for a long time. Whittaker gives an analogy of drawing on sand by one's finger. The more times one draws, the deeper become the groove. Conversely as time passes, the groove gradually erodes away.

In this connection Ebbinghaus work is worth noting. He tried to find the relation between remembering and passage of time. From his study it is concluded (1) 22% of the material learnt was forgotten within one hour, 25% in 8 hours, 30 in 24 hours, 58% in six days and 76% in 30 days, (2) From this it is clear that forgetting is more, soon after learning than with further passage of time, (3) Though the total forgetting is more, the amount of time and amount of forgetting are not proportional to each other. The theory of *atrophy through disuse* is criticised on the ground, that it is against the conception of reminiscence which is a reality. Another criticism is that time may be a factor but whatever takes place during the interval interferes and affects retention.

b) **Sleep** : Sleep is a factor which reduces forgetting. Longer the period of waking, greater is forgetting, was found by Jenkins and Dellenbach (1924). These two psychologists suggest that forgetting is brought about more by the destructive effect of other activity during waking. In a study a S was asked to memorize a list containing 10 nonsense syllables before going to sleep and the other S was asked to memorize before starting the normal day activity. The retention of each S was tested after one, two, four and eight hours of sleep or waking activity. From this study it is found ; (1) that after each successive intervals of sleep the percentage of nonsense syllables recalled by the S were : 70%, 54%, 55% and 56%. As we see the results, there is no further forgetting after one hour of sleep. (2) On the other hand, the waking S reproduced ; 45%, 31%, 22% and 9% of words. From this it is clear that longer the interval of waking, greater is forgetting. (3) The investigator concluded "that forgetting is not so much a matter of the decay of old impression and associations as it is a matter of interference, inhibition, or obliteration of

old by the new".

(c) **Relative inactivity** ; From the studies on cockroaches it is found that it is not time per se that makes us forget but what happens in time causes forgetting. The activity that takes place between original learning and recalling of it affects retention adversely. If the activity is learning of something, the effect is still more.

(d) **Absence of appropriate stimuli** : Sometimes forgetting may occur because the appropriate stimuli for recall are absent. We may be oblivious to some earlier experiences. It may not be recalled since childhood due to absence of appropriate stimuli. But suddenly we may recall it. This is so because, some sensory stimulus which is associated with experience due to conditioning at the time of original experience provokes it. As we do not know the relation between the sensory stimulus and the experience when we recall an experience due to some stimulus we will be surprised at it. So the author (Penfield) states "Regardless of the nature of memory traces, it is quite evident that, we sometimes forget because the stimuli for recall, for activation of the traces are lacking".

(e) **Obliterating memory traces** : Certain conditions obliterate memory traces. One such condition is electroconvulsive shock (ECS), which is used in the treatment of mental patients. This ECS produces amnesia for events which immediately precedes it. Patients forget the preparation made just preceding the shock, his admission to the hospital, and even the shock given to him. Experiments on rats have shown that administration of ECS after each trial of learning has greatly retarded learning. Shock after learning has destroyed retention to a great extent. How ECS interferes with retention is not known. However some researches made on animals suggest that the convulsion caused by ECS destroys the traces and not the shock alone causes forgetting. The electric current destroys the brain cells and causes forgetting. There is a belief that memory traces need consolidation and fixation. The electric current, the convulsion, the anoxia of some other condition associated with ECS interfere with this process and cause forgetting. In this connection Woodworth and Schlosberg

say "that anything learnt or experienced just before the shock may be irretrievably lost. because, its traces were not sufficiently established."

Emotional shock will also have the same effect on retention because it also interferes with consolidation of the memory traces. This is observed from amnesia for events just preceding emotional upset. In one of the studies a college student who was seated in a very dim lighted room, was given a list of nonsense syllables to learn. After learning to recall as many nonsense syllables as he could, he was given mirth provoking jokes and then asked to recall. From the results it is clear that there was no effect of jokes on recall of nonsense syllables. Another time unexpectedly he was subjected to a marked emotional upset after recalling a list of nonsense syllables just presented. That is, back of the chair was made to collapse, an electric shock was given to left arm, an iron bar was dropped from the ceiling, lights went off, pistol shot rang out etc. Soon after the commotion was over, the S was asked to recall the syllables again and found his retention was affected very badly.

#### (1) Inhibition :

An important cause of forgetting in every day life is the conflict between what has been learned and the subsequent learning. One interferes with recall of the other. With respect to retention, there is negative transfer. If learning of one habit interferes with retention of subsequent habit: it is called *proactive inhibition*. Learning of second habit if interferes with recalling of first habit is known as *Retroactive inhibition*.

(1) **Proactive Inhibition** : If the earlier learning interferes with learning and inhibits, it is known as proactive inhibition. Proactive inhibition may be due to *intrusion*, where there is substitution of word or words from one's own vocabulary for the word one reads actually. For example ; If the printed passage is—that *human brain is composed of some 10 billion nerve cells, more or less alike. which interact in various ways.* The S reproduces it as, *the human brain has some 10 billion neurons more or less alike, which interact in numerous ways...* This kind of proactive inhibition can be found while checking

word by word. Sometimes there will be omissions, commission, changes, erroneous testimony etc. In each case there is intrusion from earlier experience, which interferes with, or supplant particular features which we are trying to recall.

If the previous learning is stronger than the present one, the present one only takes more time to learn but also will be forgotten soon because earlier one interferes with and even destroys the later learning. On the other hand if the earlier learning is poorer than the later one, proactive inhibition is less. If there is greater similarity between the earlier and later learning, proactive inhibition is greater. General design of the experiment.

Experimental group	General group
Learn List A	Learn List B
Learn List B	Rest
Recall List B	Recall List B

(2) **Retroactive Inhibition** ; Interference and inhibition of the earlier learning by later learning is known as retroactive inhibition. This is one of the major causes of forgetting in every day life. The interpolated activity between the original learning, and recall of it causes forgetting. If interpolated activity is similar and if it follows immediately after original learning, retroactive inhibition is greater. On the other hand if the original and interpolated activities are dissimilar and one follows the other with time gap retroactive inhibition is less. Thus there is a close relation between the degree of forgetting and the similarity of the interpolated activity, which causes retroactive inhibition.

Now why does interpolated learning interfere with retention is the question. Indeed a number of probable reasons are offered by psychologists : (a) Learning new material leads to unlearning of the old one, in the sense, that the new responses supplant the old. (A. W. Melton and W. J. Von Laczum). (b) The items learned formerly tend to intrude themselves during tests or retention (A. W. Melton and J. M. Irwin). Though interpolated items are not overtly related, there may be implicit conflict from them which interferes with recall of the initial material. (c) Interpolated learning inter-

fers with perseveration with reverberating circuits. In other words, with the setting or consolidation of the original memory traces. The same principle is involved in distributed learning. (d) Interpolated material which is similar is more disturbing than the dissimilar one, (e) Further early interpolation may interfere and disturb consolidation more than later interpolation (f) The later interpolation may not disturb consolidation but cause the individual to unlearn earlier material or to confuse the new material with the old. Thus unlearning, intrusion and interference which are concerned with consolidation of memory traces, are all involved to some degree in forgetting.

(g) Set or preparedness : Forgetting depends upon our preparedness to learn and to remember. In the absence of preparedness, our learning will not only be delayed but also the learnt material will be forgotten soon. Further if the set is in the wrong direction, we go on recalling, only the unnecessary things and not the one we want. Unless we change the direction of the set, our recalling continues in the same direction.

(h) Meaningless material : As discussed already meaningless material not only takes more time to learn but also will be forgotten soon. The meaningless material does not cause attention and interest, and hence the memory traces caused will be poor or vague. This naturally causes forgetting.

(i) Motivational factor : Tasks which are interrupted before completion are more likely to be recalled than the tasks which are completed. This phenomenon is known as *Bhuma Zeigarnic effect*. The reason is that the incompletely completed tasks threaten the *self-esteem* and hence remembered. Another explanation is the moment the task is accepted, the individual develops tension. The tension continues until the task is completed. So the continuation of tension makes one to remember better than the completed tasks. When the task is completed the tension will be released and hence will be forgotten.

(j) Social factors : The factors in the social environment also influence how much is remembered. In one study the effect of *group atmosphere on recall* was made. The Ss.

were divided into forty groups of four persons in each. A story was read out to each group. Immediately afterwards the members were asked to write it down as they remembered it, without talking to any member of the group. Then each group was asked to select a leader and to recall together the story as completely as possible. Finally each S was asked to repeat his individual recollection.

Some groups were told that the experiment dealt with "co operative" effort and they were asked to co-operate with each other as much as possible. The remaining group were told, that a record would be kept for each S's contribution to the group effort, in order to determine which person had the best memory. This was to foster "competitive spirit".

From the above study it is clear; (1) Group recall was superior to individual recall in all cases. (2) Individual recall following the group discussion was superior to individual recall immediately after reading. (3) The superiority of group recall was more marked in the co-operative groups than in the competitive ones. This may be due to co-operative atmosphere or to the participation in co-operative groups Yuker (1955).

Thus we find that normal forgetting discussed so far is not merely passive decay as a function of time but it is a function of several factors.

## 2. Abnormal forgetting :

Abnormal forgetting is not due to any one of the causes mentioned compared to normal forgetting. It is mostly of recall amnesia type and hence retention will be intact to a large extent. Due to certain unusual and motivating causes recall is completely blocked. Any way it is not due to self-consciousness or stage fright. The causes are; (a) "exogenic" or external factors and (b) "endogenic" or internal factors.

**Exogenic :** As said above, if the cause is an external one, it is said to be exogenic. For example: a severe injury to the brain like a shock resulting from a fall, or a hit on the head, will disturb the memory process badly. If the injury is severe and affects the cortex, forgetting is more a retention amnesia than recall amnesia. But usually amnesia resulting from a shock is of recall type. Example : In 1972, an young lady

of 23 years by name Vasua Vulovic was working as an air hostess in Yugoslavia. One day the aeroplane in which she was on duty (due to some technical trouble) fell down near Czechoslovakia from 10,000 meters. Fortunately she survived due to timely medical aid. But she did not remember the fact that she fell down from the aeroplane and other details of the accident. Regarding all other things her memory was perfectly alright. Sometimes some emotional shocks like the death of a close relative, sudden loss in the business and unexpected failure etc., also cause recall amnesia.

(b) Endogenic : Causes from within are known as endogenic. The internal factors which cause forgetting are conflicts frustrations, repression etc. The concept of repression was introduced as a function of unconscious. Certain experiences which involve guilt, or shame, or frustration or conflicts are not palatable to conscious mind. Such experiences are repressed to the unconscious mind unaware of ourselves and hence they are forgotten. The individual will develop complete recall amnesia for such things. All those forgetting which take place because of such endogenic causes belong to recall amnesia. Such experiences can be brought out to conscious mind only by some special techniques, such as *free association, dream analysis, hypnosis, and projective tests*. According to Freud such forgetting is often caused by a very strong desire to forget it in order to avoid an emotional conflict arising from certain experiences. It is nothing but a convenient forgetting but the intention is not conscious one. For example: "Ernest Jones quotes a lady who forgot to keep her appointment with dress maker to try on her bridal gown, the day before the wedding. She recalled it only at eight in the evening. She forgot about it because she was marrying the person much against her wish. She had a lot of mental reservations regarding the marriage and so within a short period she was divorced".

Kanzaar quotes another case history of a lady who was very much worried and depressed. "One day a married lady approached a traffic police man who was on duty at a circle and she requested him to take her to her house. When the identity of the lady was asked by the policeman she

was not able to tell him her name, place, husband's name etc. She told him that she does not remember anything. The policeman understood her and took her to a Mental Hospital. Under hypnotic trance she told that her marital life was unhappy and she was loving some other person whom she wanted to marry after obtaining divorce from her husband. In order to take this decision her husband gave her an appointment to meet him at particular time and place. As her husband did not come to the place as fixed she waited for him anxiously for a very long time. This was followed by conflict, tension, anxiety, hatred and forgetting of the whole thing. While she was wandering around the place, she had forgotten her name, place etc. It is in that state of mind that she approached the policeman".

Apart from the above forms of hysterical amnesia (recall amnesia) we also come across many other forms of amnesia such as fugue, somnambulism etc. In fugue the individual suddenly forgets his name, place, profession and such other details of his past and runs away to some other place and starts altogether a new life with a new name and profession. This may last for a few days or a few months. Suddenly some incident may bring him back a complete memory of his past. Immediately the fugue state will be forgotten. This will be discussed in the last chapter under hysteria. This kind of temporary period of disorientation of time, place, name, and loss of memory for previous state is called *fugue*.

Another example of recall amnesia is *somnambulism* or sleep walking. Here also the individual is oblivious of the previous state for a short time and after this state, he is equally oblivious of what had happened during the somnambulism. All these are the examples of pathological forgetting.

### How to Improve memory

If a man has to live successfully and to attain success in any walk of life efficient memory is very essential. Whether the man is an administrator or a scientist or a student his success largely depends upon good memory in addition to specific ability and intelligence. Generally laymen, the students and the professionals complain deterioration in their memory power

with age. In order to find solution to their problem of deterioration in their memory power they seek the help of professional Psychologists. Especially the students request the psychologists to improve their memory by hypnosis. In fact the feeling that their memory is deteriorating is wrong. The memory of a person does not decrease by itself unless it is disturbed by shocks of some kind. The decrease may also take place either due to the disease or damage to the nerve cells of the cortex. If the individual is healthy both physically and mentally the chances of deterioration in the memory is a rare possibility.

If is often told by the students their memory was very good when they were in the lower classes and they were able to remember and reproduce anything after one or two readings. It is true that their memory was good at lower classes because their interests were very much limited, the fear of success or failure in the examination was absent, they used to read with deep concentration and were free from emotional disturbances. Naturally they used to remember very well whatever they read. As they go to higher classes and reach adolescence the reading material increases and their interest in various activities and especially interest in sex emerges and expand many folds. Consequently many problems crop up and disturb the emotional balance of the students, and their self-confidence will be at stake. Many a time the conflicts between the natural urges and the reality or the morality bother them much and feel guilty of such things. When they study with disturbed mind, lack of concentration and the will to learn, their learning and consequent memory will be poor. This gives them the feeling that their memory is deteriorating and they will be clamped with fear. In order to overcome this fear, they must be made to realise the reality. They must be made to understand that their memory is alright and their feelings are only transitory. As layman thinks psychologist has no miracle to offer to improve their memory overnight, but he has some suggestion to improve memory, if followed strictly. In order to improve one's memory, one has to improve learning methods which in turn helps to improve retention and consequent recall or recognition: Some of the suggestions offered to improve memory are :

(1) While learning anything we must have the "will to learn and will to remember". This helps to have clear and vivid impression of what we learn. Naturally our memory for the material learnt will be good. This is discussed already.

(2) While learning anything we must have deep concentration on the material to be learned. There must be sincerity of effort and devotion to the task in hand. All these make learning efficient and memory good.

(3) we must avoid unspaced method of learning to the extent possible and follow distributed method. The advantages of which are discussed already.

(4) To the extent possible we must avoid repetition method and spend as much time as possible for recalling while learning any material. Even this is already discussed.

(5) To facilitate consolidation and fixation of memory traces we must have rest and if possible sleep after learning a material. If the same thing is read and reviewed once again after sleep it is still better, for good retention and recall.

(6) If the material to be learnt is too large, first read the whole material and grasp the meaning and significance of the material. Then depending upon the need, intelligence and availability of time, adapt either part or whole method. Refer to earlier discussion for details.

(7) After learning we must try to avoid shocks of any type to avoid its bad effects on retention and recall. The effect of this is already discussed. Avoid taking alcohol after learning.

(8) Wherever possible we must make use of the principles and techniques of learning.

(9) Whatever we learn must try to make use of it whenever and wherever possible. Learnt material should not be allowed to be atrophied by disuse.

(10) Whatever we read, we must try to get memory images as much as possible.

(11) Anything we learn, we must try to relate or connect it with what we have already learnt well, so that we can remember well.

(12) Whatever we learn we must try to introduce in-

style and rhythm into it, so that retention and recall will be better.

(13) While recalling if there is any resistance or inhibition we must avoid recalling it then. After sometime it occurs automatically.

(14) We should not give room to the feeling that our memory is deteriorating with age and also as we go to higher classes. We must believe our memory and give an opportunity to it and it will not deceive us. If the above suggestions are followed strictly, retention and consequent recall or recognition improves to a very great extent.

### **Some Methods of study used by successful College Students :**

#### **A. Where to study**

- 1) Generally use one special place for study
- 2) Have everything you need for study at hand
- 3) Use sufficient and even light which is equal to day light
- 4) Avoid T. V, radio and other distracting stimuli
- 5) Avoid to the extent possible muscular relaxation
- 6) Avoid heavy meals before starting studies
- 7) Avoid strenuous work before starting studies

#### **B. When to study**

- 1) Review the material just before going to bed so that it will be remembered better
- 2) Start your study early both in the day and night
- 3) Study at regular hours and avoid irregularity in timings
- 4) Review immediately after the class, so that it facilitates consolidation of learning
- 5) Space the study period and do not sit and study continuously for a long period
- 6) Avoid studying similar material one after the other, so that one interferes with or inhibits the other
- 7) Do not study when attention is persistently wandering.
- 8) Do not study when you are emotionally upset.

- 9) Do not study when you are sleepy, tired or bored
- 10) Start your studies from the beginning of the year and not at the end of the year

#### C. How best to study the text book and notes

- 1) Do not read the text books as you read the newspaper and magazines
- 2) Think as you read, do not simply memorize or rehearse
- 3) Understand the meaning and significance of what you read
- 4) How often you read the material is not important, how you read is more important
- 5) If you have reading difficulties consult the reading improvement specialist
- 6) While reading the text book wherever necessary underline the important points and make a note of them.

#### D. How to profit more fully from Lectures

- 1) Sit in the front especially when the class is large
- 2) Pay attention to the lectures, and if doubts arise seek clarification
- 3) Take notes when necessary for understanding the material
- 4) Make note of everything that sounds ridiculous or that conflicts with your present belief
- 5) Note down the question which occur during the class
- 6) Review the class notes on the very day, and add some more important points from the text
- 7) Before going to the class read the lesson of the day from the texts to make use of it
- 8) If tutorial assistance is available for the entire course or a part there of make use of it.
- 9) Do not miss the lecture class and if it happens, contact the teacher concerned or the good students of the class and take their help, to make good of the loss
- 10) If the work book accompanies the text book, follow its instructions carefully, you will be benefited to the maximum.

## E. How to prepare for examination :

- 1) Do not attempt to "Cram" the night before the examination.
- 2) It is better to review than to reread everything
- 3) Do not read the text book at the time of examination
- 4) Read the points and recall the details and if necessary have prompting
- 5) Keep track of what you omit and link those details to the items you do not miss
- 6) Prepare for a few question papers of previous 5 years if possible
- 7) Ask yourself questions about each chapter and answer as if the examination is an essay type. If possible write your answers
- 8) Adequate rest and sleep on the night before examination is of paramount importance. If possible have some recreation the night before the examination
- 9) Have confidence in your preparation and abilities
- 10) Have task orientation and not ego-involvement in the examination, lest it affects you adversely

If the above suggestions are followed success is yours. definitely.

(Some of the items are taken from Virginia F. "On becoming an educated person—Philadelphia, W. B. Saunders Co 1964).

## CHAPTER-VI

# HEALTH PSYCHOLOGY

### An overview - Mind over Malady :

Two decades ago many people, doctors and health care providers were having their views, that body and mind are two independent entities, parallel to each other. From philosophers point of view, it is psycho-physical parallelism. To-day psychologists, doctors and health care providers strongly believe that mind and body interact with each other and affect mutually either positively or negatively. This change of attitude is due to an incident at Stanford University medical centre.

"A woman in her late forties went to the above medical center for a check up for her malady. She was diagnosed to have breast cancer, which had spread into her bones. This has caused her sleeplessness for days. At the same medical centre a group of eight women with the same malady incidentally sat in a loose circle of chairs in a small separately furnished room, every Wednesday afternoon and discuss their breast cancer problem. They discussed and shared their fear, anxiety and consoled each other. This discussion of sharing their experiences and feelings offered a lot of consolation and relief. This in turn not only gave them a comfortable feeling and kept them alive longer".

Psychologists and health care providers understood that a discussion group could improve cancer patients a chance to survive longer than expectation. Today such a method of group discussion among such patients has gained increasing respectability. And today we are seeing evidences that psychological intervention can have substantial impact on patients physical health. Researchers have started their investigation into scientific basis of effectiveness of such approaches in treating the patients. Thus health related issues are correlated with psychology, that is known as "health psychology" today.

"Health Psychology" is the area of applied psychology. It is concerned with the investigation of –prevention, diagnosis, and treatment of medical problems. Health psychologists are curious to know how illness is affected by psychological factors and the impact of stress on physical diseases, i.e., how health problems, such as heart disease and stress are related, and how it can be avoided by healthy behaviour.

Today health psychologists are realizing that "mind and body are clearly linked together, than remaining as independent entities (Psycho-physical interactionism). They do interact and influence each other in all respects."

Health psychologists have recognized that good health and the ability to cope up with illness are affected by psychological factors, such as thoughts, emotions, and the ability to manage stress. They have given special attention to immune system, the complex organs, glands, and the cells that constitute our body's natural line of defense in fighting diseases.

Today Health psychologists are very much interested in investigation in the field of – "Psychoneuroimmunology". It is the study of the relationship between psychological factors and the immune system. This has led to the discovery of the association between emotional state and success of immune system in fighting the diseases.

In summary, health psychologists are considering that mind and body are two important parts of the whole human being, but not two independent parts. Formerly disease was considered only a biological phenomenon, and psychological aspects are of little importance. In the beginning of this century (20<sup>th</sup>) it was believed that the primary cause of death was short term infection. Now they are realizing the major cause of death due to heart disease or cancer or diabetes are due to the fact that it is chronic and hence it cannot be cured, rather it lingers longer, and poses significant psychological issue.

Here we discuss the ways in which psychological factors affect health- (1) First, they focus on the causes and consequence of stress and the means to cope up with. (2) They are exploring the psychological aspects of several major health problems including, heart disease, cancer, and those resulting from smoking and drinking. (3) Finally, they are examining the ways in which how Doctor-Patient interact and how it influences health. And also offer suggestions for increasing people's compliance with behaviour, that will improve their well-being. In short health psychology represent a union between medicine and psychology. Secondly it is concerned with how stress affects us and how best we can cope up with it.

## Stress-Meaning :

Stress is the spice of life and hence life without stress is dull, dreary and no achievement and no suffering. Stress begins at birth and ends at death. Though stress is there throughout life, well managed optimum stress makes living pleasant, but ill managed and excessive stress makes life miserable. The difference lies in making life a friend or foe. Stress is highly correlated with civilization, and industrialization. So, the more civilized, and industrialized we are more stressful we become. On the other hand the more religious and philosophical we are the less stressfull we become. More is the advancement in science and technology, more is the stress. On the other hand the more we are value oriented in every activity, less is the stress. So any advancement in science and technology should be value oriented and specially human value oriented. It should be for the benefit of man and not for destruction. Further with the growth of population in leaps and bounds, more is the stress, because it creates innumerable and unsurmountable problems. It creates the problems of food, shelter, job, and severe competition for everything. Man has to struggle for survival at every stage and for every thing. This struggle causes severe stress and ill health.

It is said that 20<sup>th</sup> and 21<sup>st</sup> centuries are becoming more and more stressful because of, wars, cold war, population explosion, nuclear race etc. All these things are causing unbearable stress and strains to man, all over the world. So the future seems very bleak. Stress being, a negative emotion "it shatters our mind and shortens our life". Indeed it is a slow poison which is swallowing us unaware. From the above discussion it is clear that stress is dangerous both to the body and mind. The wisdom lies not in avoiding stress which is inevitable, but in learning how to walk along this arduous path of stress.(Author).

## Stress and Strains – Definition :

Both stress and strain are widely used to mean the same thing. In reality "Stress is the tense state of mind and body, due to readiness or preparedness of the body and mind, either to fight or flight from the situation or the stimulus confronting us." (Author). Due to this, there is loss of homeostasis or balance. "Strain on the other hand is the experience of exhaustion or tiresomeness due to loss of energy caused by stress. Formally it is defined as "the response to events that threaten or challenge a person". It may be examination deadline, an interview, a family problem, death of a spouse or accumulative series of small events.

Life is full of circumstances and events known as "STRESSORS". These stressors produce threats to our well being. Even the pleasant events such as marriage, birthday party, arranging a party or a function, also produces stress. But the negative events cause detrimental consequences than positive ones.

All of us do face stress in our lives. Daily life involves a series of threats to which we cope up or adapt to it, sometime knowingly or sometime unknowingly. If the stress is more severe or long lasting, coping up requires major effort. It produces psychological and physiological responses of health problems.

## Stress and Physiological and Psychological Problems:

Stress produces both physiological and psychological consequences. Most immediate reactions are biological ones, such as a raise in adrenal glands hormone—"adrenalin". This increases heart rate, blood pressure, and reduction in skin resistance. These responses are adaptive in nature. They produce "emergency reaction and prepares the body to defend itself through activation of sympathetic nervous system. These responses help to cope up with the stressful situation or event.

Apart from major health problems, many minor aches and pains also appear – such as, headache, backache, skin rashes, indigestion, fatigue, constipation, common cold and what not. In addition to these minor problems, some major problems like "Psychosomatic disorders" manifest. These medical problems are caused by an interaction of psychological, emotional and physical difficulties. Some of the psychosomatic disorders are, Ulcers, Asthma, Arthritis, high BP, migraine, gastritis, eczema.

Apart from the above psychosomatic problems, a person subjected to severe stress for a long time may develop purely psychoneurotic problems, such as hysteria, anxiety, obsession – compulsion, phobias, neurosthemia etc. These are minor psychological problems. Subjected to severe and prolonged stress; a person may also develop major psychoses, such as schizophrenia, manic-depressive psychoses, paranoia, involutional melancholia etc.

### Is Stress necessary ?

As said already all living beings need challenges or demands, for stimulation to serve or to do something. Specially human beings need more stimulation than lower animals, to live and to achieve something in life. Man's environment is more stimulating than the

environment of lower animals. This stimulation may be from within or without, which causes stress. We know that living without stress is dull and dry and hence will have no interest to live long. Soft and smooth living is not at all attractive, where as challenges or demands are enjoyable. They promote performance to the maximum. So stress which is held under control and managed properly helps to achieve much in life. If it is exploited in the area of our ability and interest, it helps to achieve much in life.

For primitive man the challenges were minimum and largely physical and biological and hence limited to secure food, shelter, protection and security. In short challenges were limited to satisfaction of basic biological needs and race preservation. But today physical challenges are less, whereas intellectual, emotional and social challenges are more. Some of them are self created and many of them are thrust on him by physical, social, cultural, religious and political environment. These challenges crop up at the work place, at home, and at the time of social interaction with the fellow beings.

## **Eustress:**

Any work or challenge causes stress and it will have necessary psychological and physiological changes and the result is a pleasant or unpleasant experience. Eustress is defined as "a pleasant or curative stress". We cannot always avoid stress and sometimes we don't want to avoid it, because the result is pleasant. It promotes achievements in life. As said in the beginning of this chapter, all great achievements will have stress behind. Eustress is controlled, regulated, and directed to achieve something in life. If you read the biographies of great men you will understand, the stress they have lived through to achieve their goals. This Eustress gives us competitive edge in our performances and related activities like sports, athletics, research, etc. It also provides us with focus, and "competitive edge", that help us to think quickly and clearly and express our thoughts in ways that will benefit us.

Some stressors can cause both good and bad stress. For Ex: Radiation if left uncontrolled, may cause cancer. The same radiation if controlled and pin pointed, helps to cure some cancer. In the same way physical exercise is a good stressor. If it is done more than our body limit, it causes injury and illness. When our body is fatigued or weak, it results in a variety of injuries and it predisposes to illness.

## Distress :

Distress is an upset, unpleasant, disorganised and emotionally disturbed state of mind and body. Consequent upon this, many biological (physiological) and psychological changes take place within the individual. As it is emotionally charged, heart beat rate, BP, breathing rate and depth of breathing, increase. Digestive and excretory functions are disturbed. Psychologically sensations perception, attention, learning, memory and reasoning become upset and some of them become totally paralysed. In fact, there will be a totally confused state of mind, and its functions.

Distress is due to emotional or psychological trauma. Emotional trauma is caused by war, rape, kidnappings, abuse, torture, disappointment, dismissal from service, etc. It is also caused by some common events such as accidents, break up of cordial and significant relationship humiliating experiences, failure in the examination, loss of job etc.

Though stress and distress are tense and disturbed states of mind and body, there are differences between the two. Stress is normal and it has a good direction, planning effort and perseverance, where as distress is abnormal, and has no goal, no direction, confusion, agitation, restlessness etc. Consequent upon distress, there is disturbance of eating habits, sleeping habits, sexual dysfunction, low energy, chronic and unexplained pain, emotional depression, spontaneous crying, helplessness, despair, anxiety, compulsive and obsessive behaviour, irritability, anger, resentment,

withdrawal from normal routine activities, memory lapses, difficulty in making decision, distractability, amnesia, guilt feeling, grief, altered sense of time and place, hyper \* vigilance, Juminess, over reaction, Insomnia etc.

The distressed individual needs patient hearing, counselling body-mind relaxation, yoga, pranayama etc.

## Threshold of Stress :

Stress is good or bad but it is necessary, because it acts as protective reaction to any challenge that confronts us. It also helps to achieve much in the field that suits us. But unfortunately excessive stress and its unpleasant effects can manifest in a variety of ways. It causes disturbed behaviour and undermines physical and mental health. Deprivation of food and sleep universally causes severe stress. Apart from these situations which cause severe behavioral problems, people vary widely in experiencing adverse effects caused by stress. Some people adjust easily to the demands of the situation and some people break – down.

The threshold at which the individual adjusts or breaks down vary with emotional and personality maturity, and tolerance quotient of the individual. The threshold also varies with the circumstances, age, sex and the training of the person. A person may adjust to the stress of the job, but may find it difficult to adjust to the demands of parenthood, Love-relationship and other personal problems.

Stress threshold is also determined by many other factors such as –(1) Personality make-up (2) Self-discipline (3) Discipline imposed by the society and the circumstances. People whose lives and relationships considered to be stressful will have maximum tolerance for many stressful experiences. These people have learnt from their experiences how to cope-up with stress and to overcome it, but they also know how to adjust their aspirations and to the realities of life. Normally their morale will be high and health will be good.

Excessive stress is harmful to the individual who can't withstand it. This excessive stress and its effect depends on the individual, but doesn't apply to all. Excessive stress is a part of the behaviour pattern of the individual with the following symptoms – (1) Urgency and importance. (2) Aggressiveness and excessive competitive motive (3) well rationalized hatred and hostility (4) Deep seated insecurity (5) High aspirations (6) unplanned activities (7) Irregular habits. (8) Bad models.

## **Classification of Stress :**

Stress is something which disturbs the equilibrium of the individual. This disturbed state continues till the task is completed, or the problem is solved. Stress is classified into three types – (1)Physical (2) Mental (3) Emotional.

**1) Physical Stress :** Physical stress comes from excessive heat, chill, hard work, long working hours with no rest, carrying a heavy object, climbing flight of stairs, traveling in a crowded bus, injury, illness, infection, heavy exercise, walking long distance and fast running etc.

**2) Mental Stress :** Mental stress is caused by severe conflict, unbearable frustration, pressure from within and without, disappointment, and threat from outside etc.

**3) Emotional Stress :** Emotional stress comes from death of a spouse, parent or siblings, jealousy, envy, failure in the examination or interview, loss of job, or loss of promotion etc.

Stress can also be classified into two categories : (1) Passive stress (2) Active stress.

**(1) Passive Stress :** Passive stress is not a serious challenge or demand. The situation is endurable. Though the individual is tense for sometime he will adjust to the situation in a short time. Eg: Missing a train or bus, not getting a ticket for a movie, going late to a function etc.

**(2) Active Stress :** Active stress is a challenge which confronts the individual and makes him to prepare physically and mentally either to fight or flight. This condition continues till the task is completed. Consequent upon this, adrenalin goes up, heart rate and B.P. rises, immune system and electrical resistance of the body decrease. As a result of all these changes within the body, the individual feels exhausted. Eg:- Appearing for a public examination, or an interview for a job, delivering a public lecture, accepting a difficult job, taking care of a spouse with terminal disease etc.

**Classification of Stressors :** Stressors are classified into three categories on the basis of events confronting : 1) Cataclysmic events (2) Personal events (3) Background events.

**1) Cataclysmic events (Stressors) :** Cataclysmic events are very strong and occur suddenly. They affect severely hundreds or thousands of people simultaneously. Eg: Earthquake, Train or bus accident, Floods, Drought, Famine, etc.

**2) Personal events : (Stressors) :** Personal stressors are major painful events of life such as Death of a spouse or a close relative, loss of job, Failure in the examination, Disappointment in love etc. These events produce immediate reaction (startling) which gradually reduce with lapse of time. But in some cases, they last longer. Eg: The Experience of rape.

**3) Background events (Stressors) or Daily hazzles :** These stressors are minor irritations of every day living. Eg:- Traffic noise, undue delay, noise of mikes etc. These daily hazzles don't require much coping up, but in summation, they become more stressful.

## How do we react to stress ?

Different parts of our body continuously work together in harmony. They also react continuously to the demands made on us from within and without. Some of the demands threaten our

body and mind and prepare them either to fight or flight. These reactions will be usually in the form of reflex actions and gradually become responses.

**Reactions of the body :** Different parts of our body react in their own way and in co-ordination to meet the demands. One such structure is "Hypothalamus". Hypothalamus is located at the base of the cerebrum. It becomes activated and stimulates the pituitary gland to release tropic hormones. One of the tropic hormones is adrenotropic hormone which stimulates adrenal gland (medulla) and releases adrenalin, and other hormones which have wide range of effects on the body. Consequent upon this, some of the body activities increase and other body activities decrease – such as -  
(1) Aches and pains of muscles due to slow mobilization of lactic acid. (2) Liver releases glycogen into blood stream to provide energy to the concerned part of the body to fight or flight. (3) As the blood drains away into muscles, skin becomes pale. (4) There is increased production of sweat to cool down the body. (5) Dilatation of the pupil of the eye (6) Salivary glands stops secretion of saliva and cause dryness of mouth. (7) Rate of breathing increases to supply more oxygen to muscles. (8) Palpitation increases to supply more blood to muscles. (9) Blood pressure rises (10) Kidney work less efficiently due to reduced blood supply. (11) Digestion, either reduces or stops. (12) Due to contraction of spincter muscles, the defecation stops or there will be diarrhoea and frequent urination. (13) Due to impairment and immune system, allergic reactions appear, and resistance to disease decreases.

**Reactions of the Mind (Mental Symptoms):-** Consequent upon stress, the individual shows the following mental and behavioral symptoms – such as- (1) Development of phobia or obsession (2) Loss of self confidence and self – esteem. (3) Feeling of guilt (4) Dread of future (5) Deterioration of concentration and memory (6) Irritability and anger. (7) Feeling of loneliness (8) Filling the

day by trivial tasks (9) Indecision (10) Crying or weeping. (11) Racing of mind etc.

## **Sources of Stress :**

The sources of stress are many and varied. However, the main sources commonly confronted by an individual are – (a) Frustration (b) Conflicts (c) Threats (d) Pressures.

### **Frustration : Frustration as a source of Stress:**

Frustration is a bitter feeling and an unpleasant experience caused by failure to achieve our goal or caused by blocking or thwarting of the desired goal or action which is valued very much by us. So long we live in the social and cultural environment, frustration is unavoidable. Then we have to give up our goal or postpone or reduce or change our goal, to fit into the society. Frustration may be mild or intense and this effect is proportional to its intensity, situation, importance attached to it, age, sex, and attitude. Eg: - When we want to go for an interview or public examination, if our vehicle fails or the public transport is not available, we feel very much frustrated. In the same way, death of a spouse, divorce etc cause frustration and we feel miserable and helpless. When we are frustrated, we are disturbed, agitated, violent or depressed. Sometimes the cause of frustration may be physical environment or personal inadequacy.

### **How do we react to Frustration ?**

Just as frustrating situations are varied and many the reactions or the responses are also varied and many. Some of the common reactions are – (a) Anger (b) Hostility (c) Aggression.

**(a) Anger :** A very common reaction to frustration is anger and it is an impulse to repel, hurt, fight the person or the situation responsible for frustration.

**(b) Hostility :** Hostility is an "attitude of ill-will". It is a feeling

of enmity with an impulse to hurt the person who is responsible. It may also manifest to the form of gossiping, making unkind remarks or avoiding the person responsible.

**(c) Aggression :** It is an act of attacking, injuring or destroying the situation or the person responsible for frustration.

The other reactions to frustration are - Sulking, pouting, fortitude or relinquishing the goal.

## **B. Conflict :Conflict as a source of stress :**

Conflict is a clash between two desires, two goals, two values, two ideals or two interests. Each one of the pair pressurizes equally for fulfillment. This decision to choose one, will compel the individual to give up the other. This decision causes a lot of tension and stress as both the choices are equally strong. Consequent upon this, the individual feels he is in a fix and suffers lot of stress. Thus the individual will be confronted with a number of conflicts which are varied in nature.

### **Classification of Conflicts :**

Conflicts can be classified into three categories :

(1) Approach – Approach conflicts, (2) Avoidance – Avoidance conflicts, (3) Approach – Avoidance conflicts.

**(1) Approach – Approach Conflicts :** Both the goals are equally desirable and strong, but the individual has to select one and reject the other. The choice is totally left to the discretion of the individual, but it is very difficult to make the choice. Eg: A student secures high percentage of marks in P.U.C. and high ranking in CET Examination for both Engineering and Medical courses. He is equally interested in both the courses but he has to choose one. So he experiences severe conflict to decide whether to go for Engineering or Medical course.

**(2) Avoidance – Avoidance Conflicts :** Here, both the choices are equally strong and undesirable, but the individual has to make a choice and accept one. Eg:- A poor and unemployed graduate has to choose between accepting to marry an unattractive girl or to continue to be in unemployment. He will get the job, only if he accepts to marry the girl. The choice is very difficult and unpleasant.

**(3) Approach – Avoidance Conflicts :** Here, the conflict is between a strong tendency to accept or to avoid the same goal. Eg: A strong desire to marry for sexual, social and security reasons, but fears very much the responsibilities of married life and loss of personal freedom. The choice is inevitable, and the stress unavoidable.

### **Effects of Conflicts :**

Conflicts for any reason and of any intensity is not desirable. It causes stress and consequent anxiety until it is resolved. It is said that conflict is an inevitable cause for neurosis or psychosis or psychosomatic disorders. Conflicts unresolved cause tension, restlessness, irritability, sleeplessness and so on. But all conflicts are not severe and damaging. But some of them can be resolved easily in a short time, whereas some require more effort and time. The last category of conflict will have serious impact both on mind and body.

### **How to Resolve Conflicts :**

There are several ways of resolving conflicts. (a) In olden days to resolve conflict regarding an important issue, people were going to the temple of their diety, and after pooja, requesting God to give flower from right side if their decision regarding an issue is going to be beneficial or to give flower from left side if their decision is harmful. (b) Another way is to resolve conflict and to take a decision is to write on two slips – “One to do” and another “not to

do", and fold each slip separately, put them in a bowl, and requesting an innocent child to pick up any one of the slips, and then decide according to the slip picked up. (c) The third way is tossing a coin to decide. In all these three, chance factor plays a significant role. (d) More scientific way of taking a decision regarding an issue is – to list out all the plus (+) points about the issue and minus (-) point about the issue separately. If it has more plus points than minus points, take the decision in favour of the issue. Once the decision is taken do not look back. Do not jump to any conclusion and do not allow any old conflict to continue. If such a thing is done, it leads to tension, anxiety, and consequent strain.

### **C. Threat is a Source of Stress :**

Threat signifies the possible impending danger to physical or psychological self. Example : Threat of nuclear war, fear of drought, cancer, AIDS, etc.

Threat may also indicate interference. Interference may be with ones activities, plans, ambition etc. This threat may be mild or severe. Source of the common areas of threat are striving for recognition, success, or acceptance.

### **D. Pressure as a Source of Stress :**

Pressure is a force either from within or without to do something which he is not capable of. Sometime ambition to achieve something of which he is not capable of forces him to do. Here the pressure is from within. Sometime parents may force him to achieve or to do something which he is not capable of is a force from outside. Example : Parents forcing their son or daughter to study day and night to get high percentage of marks in PUC-PCB and to get high rank in CET, to get into medicine. Some time the student may himself may work hard to get high percentage and rank to get into medical course. In both the courses, it is the pressure that causes severe stress. Sometime, the pressure may come from

commitment much which causes stress. Sometimes pressure comes from procrastination of studies till the tail end of the academic year and starting his studies just 2 or 3 months before the examination.

## **Reaction to Pressure :**

Reaction to pressure depends up on the nature of the person, sense of responsibility, duration of pressure, intensity of pressure, personal health, attitude towards life etc., The pressure may be from within or from outside, if it continues for a long period it tells on his ability to relax, emotional control, efficiency, and his health. Pressure often causes frustration, and invokes hostility towards the person who is responsible. The person under pressure becomes ill-humored and irritable.

## **How to manage Pressure ?**

Psychologists have suggested some measures to manage pressure, such as ;

- a. If time is a factor for pressure, it is better to start work earlier than late. Ex.: Students have to start studying from the beginning of academic year, than from tail end of the year. Here it is worth recalling the great saying – “slow and study wins the race”.
- b. If possible, have some time for recreation periodically to have relief from tension caused by pressure.
- c. If one is conscientious, he must be frank enough about his abilities and limitation to fulfill the ambition of his parents, or of his self.
- d. Limit the load of the work to fit into his ability and time at his disposal.
- e. Practice regularly body-mind relaxation everyday (see for details the last aspect).

## **Ways of adapting to Stress :**

When we fail to cope up with stress by attack, withdraw or compromise, we resort to defense oriented reactions in order to defend our ego which is hurt. These defense oriented reactions are sponsored by unconscious. These defense oriented reactions protect our ego in an unrealistic way and offer temporary relief from defeat or failure. If we totally depend upon them for relief from stress, we develop psychological or psychosomatic disorders.

These defense oriented mechanisms are of three types;

1. First, group of reactions are – crying or weeping, unnecessarily smiling or laughing, talking repetitively etc., These behaviour serve as psychological repair mechanisms.
2. The second group of reactions to stress are – smoking, drinking alcohol, drug addiction etc. These reactions help us to forget the pain, agony, anxiety, worry, etc., caused by stress. These reactions will help to forget pain or suffering temporarily, but at the same time create health hazards.
3. The Third group of reactions to stress are ego-defense reactions, they help to protect our ego against threat. They also help to maintain psychological integration and protect against "self devaluation". But, if they are used beyond certain limits, they become symptoms of either psychoneuroses or psychoses, or psychosomatics and thereby interfere with adjustive demands.

## **Relaxation Tool to Reduce Stress :**

One must learn to relax to overcome stress, but it is not so simple to do so. Merely, lying down on a soft bed, closing eyes or sitting on a relaxing chair closing eyes, may help you to relax a little, but it is not total relaxation. It is a technique to overcome stress, by developing a kind of self-control and to meet the stressful social situations of every day living. It is also a technique which

helps you to relax even amidst hectic social, or official, or domestic activities.

## I. How and when to do Relaxation :

Here are a few steps to be followed to practice relaxation to be effective- A-Dont's .....

1. Do not try to learn relaxation when you are feeling tired. You will learn better and more effectively when you are alert.

2. Try to minimize background sources of stress like noise and presence of other people.

3. Do not rush or watch the clock. If you are worried about going on too long, set alarm to give a ring after a stipulated time.

4. If you are not succeeding, do not try hard again and again. This adds to your stress. Instead of trying hard better to rest for a few days and then start again. Emphasise on the part of exercise you find it effective.

5. Before doing relaxation, take these precautions –

a. Choose a quiet and comfortable place.

b. Loosen your clothes and remove your shoes and glasses.

c. Sit or lay down as comfortable as possible.

d. Close your eyes, uncross your legs, rest your arms on your sides and keep your palms open and upturned.

## B – Do's :

After relaxing each part of the body :

a. Toes : Curl your toes towards you or down to the floor.

b. Calves : Point your toes towards your face.

c. Buttocks : Push your buttocks hard against your chair or bed. At the same time try to make your body feel as heavy as possible.

- d. **Abdomen** : Tense your abdomen as if preparing to receive a punch in the stomach.
- e. **Shoulders** : Shrug your shoulders as high as they can go.
- f. **Throat** : Use your chin to press your throat hard.
- g. **Neck and Head** : Press your neck and head against the back of your shoulders, stretching your neck as you do so.
- h. **Face** : Tighten as many facial muscles as possible, including forehead, jaw, chin and nose.

## **II. Quick Relaxation :**

If there is no time to complete the full procedure or if it is not convenient, use the following actions – Tensing and relaxing as above. You can perform such actions unobtrusively in all kinds of situations.

- a. **Tighten and Tense the whole upper part of your body.**
- b. **Pull in your abdomen and tense your buttocks.**
- c. **Try to force your body off the chair by pressing the soles of your feet hard against the floor and trying to lift your body using your calf and other leg muscles.**

## **III Self Talk :**

Use the following examples to work out some possibilities for yourself.

- a. **“It might be difficult, but I am going to go through the argument with them again”.**
- b. **“I must turn down that extra work. I can cope up now, but with extra I will be overloaded”.**
- c. **“I know I am being yelled at, but she is under stress too and has probably had a bad day”.**

(After this, read "Body mind relaxation technique" of P. Nataraj – "Stress and management of stress").

## Development of Undesirable Habits :

As said already we may resort to or develop some undesirable habits to overcome stress, such as smoking, drinking and drugaddiction.

**1. Smoking :** We take to smoking to find relief from stress. No doubt, it gives relief from stress for sometime. With the lapse of time, it becomes a strong habit and becomes a slave to it. We start smoking when we are upset about something dear to us and when we are worrying. In our social, cultural, and religious world, and with a lot of development in science and technology, frustration, conflicts, pressures and threats are unavoidable. Then we start smoking to find relief from stress. When we find relief and pleasure, we continue to smoke more and more and thus we become a slave to smoking, we also develop a strong craving for cigarette. Then if we do not smoke, we become restless. Thus we become addicted to it.

This smoking is the largest cause of illness and premature death. It is the leading cause for several types of cancers, including cancer of the lungs, larynx, bladder and cervix (in women). It also causes cardiovascular disease i.e., the disease of the heart and blood vessels. In spite of numerous risks associated with smoking and health benefits of quitting, more than 25% of the people are smoking. The harmful effects do not end with smoker. Smoking during pregnancy can also have harmful effects on the developing foetus. It also affects the people around the smoker.

From the studies it is found genetic, psychological and cognitive factors seem to play their roles in smoking. It is found that some people are ;dft5

1. "Biologically predisposed" to become addicted to nicotine (tobacco) and others remain unaffected. Nicotine enhances the availability of certain neurotransmitter substances (including acetylcholine, norepinephrine, dopamine and endogenous opioids). These substances produce temporary improvements in concentration, recall, alertness arousal and psychomotor performance, which are extremely pleasurable to some people.
2. Psychological factors also play their roles in establishing smoking behaviour, among youngsters. Adolescents are more likely to begin smoking if their parents or other role models smoke, or if they experience peer pressure to do so.
3. Cognitive factors seem to influence people's tendency to continue smoking. Smokers will have wrong notions that smoking increases their health. They also underestimate the risk of smoking.

Government and various health agencies are taking various measures, to make smokers to give up smoking, and to prevent others taking to smoke,

1. The first one is making antipropoganda against smoking by video tapes, audio tapes, and pamphlets.
2. The content of smoking cessation interventions and specific behaviour change programmes are also used.
3. Most effective one is "aversive procedures". It is designed to associate smoking stimuli with feeling ill. (aversive therapy).
4. Intensity of the person-to-person contact, where the clinician spending some time with the smoker. More contact leads to higher cessation rates.
5. Using nicotine replacement therapy (method of incompatible response) i.e., introducing a substitute to smoking. Example : Chewing nuts, using beeda, etc..
6. A potent new weapon against smoking is "Threat of impotency". Scientist know the link between smoking and sexual problems,

i.e., smoking can harm man's sexual functions, because it constricts blood vessels which supply blood to sex organ which causes erectile dysfunction.

## Alcoholism – causes and effects :

Another way of avoiding or forgetting the severity of stress is drinking alcohol. Both men and women take alcohol to overcome feelings of depression, to reduce anxiety and to neutralize resentment caused by intense stress, be it personal or background in nature. It provides emptiness and futility of ones existence. It serves as an unconscious means of expressing self-destructive tendencies. People continue to drink because it fills whatever psychological function is called up on to perform. Though immediate effects are satisfying, in the long run the results are harmful, once the habit is firmly established. Further, it continues automatically and becomes more and more harmful and hence it needs treatment.

No doubt alcohol gives relief from stresses and strains, but it is only temporary. In no way, it helps him to overcome the problem, rather makes his life more miserable and compels him to become more addicted to it.

Drinking alcohol starts as "social drinking" continuation of it leads to psychological dependency. Still further it also leads to physiological dependency. This is indicated by loss of control over drinking, a craving for alcohol, adaptive cell metabolism and withdrawl symptoms.

At this stage, the individual needs not only medical therapy, but also requires behavioural modification, individual therapy, family therapy and group therapy.

Moderate alcohol consumption can reduce the risk of coronary heart disease. Red wine appear to stem from compounds called, "Phenolic antioxidants". This seems to exert its protective effects by reducing, cholesterol and inhibiting blood clotting. Moderate alcohol consumers may even live longer than non-drinkers.

Too much alcohol consumption is harmful and has damaging effects on our health. Chronic excessive drinking leads to deficits in many cognitive abilities, including learning and memory, perceptual – motor skills, visual spatial processing and problem solving. The negative effects of excessive drinking affects our health. It leads to stomach disease, cirrhosis of liver, cancer, impaired sexual functioning and cognitive impairment. Heavy drinking may also lead to suicide and suicide attempts.

It is found from studies, that the probability of occurrence of alcoholism is more with identical twins than fraternal or non identical twins. Environmental factor also contributes to drinking.

## Emotions and Health :

Emotions play very significant roles in our lives. Pleasant emotions make our living happy and worthwhile, whereas unpleasant emotions make our living unpleasant and worthless. They either add longevity to our living or shortens our living. Every moment we are under the spell of our emotions and they are the salt of our living. Negative emotions like anger, fear, anxiety, phobias, hatred, jealousy, envy, etc. if not expressed adequately will have adverse effect on the progression of certain illness, such as cancer. People who inhibit self expression and experience negative emotions in social interactions are branded as "Type Distressed personality type". The individuals who cope up with stress by inhibiting their negative emotions within themselves, are likely to experience suppressed immune systems, greater recurrence of cancer and high mortality rate. On the other hand, patients who demonstrate positive emotions like Joy, happiness and well-being, will have greater chance of recovery from any ailment and especially from cancer.

In a study on "the relation between expression of distress and treatment outcome", it is found that an open expression of negative emotions and desire to fight illness are sometimes related with

greater immune system, decreased recurrence rates, and increased survival time, even during advanced stages of cancer. The combative individuals who express anger about getting cancer and hostility towards their doctors and family members-often live longer than patients who passively accept their fate and quietly undergo treatment.

Emotions also play a role in the progression of "hypertension or high blood pressure". Prolonged hyper tension, if not treated causes extensive damage to the entire circulatory system. Extreme reactivity to anxiety, hostility, and anger cause predisposition to hypertension. They also cause asthma, gastritis, ulcers, migraine, skin troubles, etc., if not controlled and regulated. Yoga, meditation, and body mind relaxation help to control and to regulate emotions.

## **Diet and Nutrition : *What we eat may save our lives***

Diet and nutrition play significant role in our living. They are the basic necessities of living. Nevertheless they also cause diseases and even death. It is said poor dietary practices increase the risk of developing chronic diseases. Poor diet is closely linked with cancer of the colon and rectum. Colorectal cancer is one of the leading causes of cancer death. On the other hand, regular consumption of certain food, particularly fresh fruits and vegetables reduce the risk of developing these cancers. In addition, regular exercise has protective effect against the development of colorectal cancer.

Again, diet is a significant factor in the development of "Cardiovascular disease", i.e., disease of heart and blood vessels. Such as arteriosclerosis (hardening of the arteries), coronary heart disease (reduced blood flow to the heart muscles), and stroke (Bursting of blood vessels in the brain). Most cardiovascular

diseases affect the amount of oxygen and nutrition deficiency. This causes permanent damage to the organs of tissues and even death. Arteriosclerosis is the major cause of heart disease.

High levels of "serum cholesterol" or blood cholesterol is strongly associated with increased risk of cardiovascular diseases. Cholesterol clogs arteries and cause the risk of heart disease. The amount of cholesterol in our blood is affected by the amount of fat, (saturated fat) and cholesterol in our diets. Serum cholesterol can be reduced much through diet that is low in fats, cholesterol and high in fibre fruits and vegetables. So, it is necessary to motivate people to eat right type of food, but it is not so easy to educate to eat right type of food.

## AIDS :

Acquired Immuno Deficiency Syndrome is a viral disease, which reduces the immune systems ability; to defend the body against the introduction of foreign (outside) substances (antigens). The Process by which HIV (Human Immuno-deficiency Virus) produces AIDS symptom is complex. This process essentially involves the devastation of aspects of the infected person's immune systems. This makes the infected person extremely vulnerable (susceptible) to diseases, such as, tuberculosis, pneumonia and several forms of cancers.

Studies have revealed some frightening facts about AIDS.

1. The estimated incubation period i.e., the time it takes for the disease to develop is about 10 years. This means that infected person can spread the disease to others without knowing that they are infected.

2. The individual can be infected only if the virus is introduced directly into blood stream. This means the disease cannot be contacted through, shaking hands, or by hugging the patient. HIV

infections are acquired through unprotected sexual intercourse and infected blood or blood products. This means that women can pass on the disease to their unborn children during pregnancy or delivery or through breast feeding.

3. Until only a few years ago, HIV infection was a virtual death sentence, as it was always fatal. Since 1995, Scientists have developed more effective drugs to attack it. Two classes of potent drugs are "Protease inhibitors and Transcriptase inhibitors". These drugs block the HIV from replicating once it has invaded certain cells of the immune system. They have also developed tests to monitor viral levels directly, so that doctors can accurately gauge the effectiveness of therapy.

## **How Psychologists can help prevent the spread of AIDS :**

One reason is, that most people contact HIV as a result of certain behaviour. Initially, it was believed that AIDS is restricted to homosexuals, and intravenous drug users. Today, it is found that AIDS spreads through unprotected "heterosexual" rather than homosexual intercourse. Psychologists are interested in this problem. The effective means of combating AIDS is to use prevention programmes. This programme focus on changing the behaviour, of people. People must be made to become aware of the facts, that AIDS affects if a needle which is used to inject drugs to a person who had resorted to unprotected sex, or sex with multiple partners, is used to another person.

Health psychologists recognize the developing effective AIDS prevention programs is a complicated business. Merely teaching people the facts about HIV and AIDS are often ineffective. The technique which is effective for one target group is not necessarily effective to another group. One Model that is useful in developing

intervention that accommodates individual and group differences, is the "information-motivation-behavioural skills (IMB) model. According to the IMB model, people are more likely to perform HIV preventive behaviour to the extent that they – (1) Know how HIV is acquired and specific actions they must take to avoid it. (2) They are motivated to perform HIV – preventive behaviour and give up risky ones. (3) They possess the skills necessary to perform relevant HIV preventive behaviour, i.e., the ability to communicate with and to be suitably assertive with a potential sexual partner.

**The HIV preventive behaviour technique should be suited to the target groups.**

**One group at risk is "women". HIV infection rate with women is growing rapidly. There are several reasons for it.**

**1. The way in which HIV transmission differs between men and women.**

**(a) Most women acquire HIV as a result of intravenous drug use. Women who use drug add to their risk of contacting HIV, if they have unprotected sex with male partners who may also use drugs or have multiple sexual partners.**

**(b) Another Factor unique to women is the chances of male-to-female transmission of HIV is 12 times greater than those female-to-male transmission.**

**2. Secondly, Gender role differences between men and women is another factor. Women adhere to traditional gender roles. They succumb to pressure, to engage in unprotected sex. She cannot persuade her partner to use condom. She cannot refuse sex if he does not agree to use condom.**

**3. Fear is an important factor, with women in abusive relationship marked by physical violence – women who have potential fear of**

injury, are reluctant to negotiate safe sex with their partners, let alone refuse to have sex with them.

**Hence the role of Psychologist is to develop :**

**HIV prevention training program in such a way that,**

**1. Increases the women's knowledge of HIV transmission and prevention.**

**2. Motivates the women to perform HIV preventive behaviour by highlighting their specific risk of acquiring HIV.**

**3. Provide the behavioral skill necessary to convince their sexual partner to adopt HIV preventive behaviour, such as wearing a condom during sex. These IMB model found to be more effective in preventing the spread of AIDS.**

## CHAPTER 1

# OBSERVATION

*Introduction :* Observation is an act which helps us to have knowledge of the environment. This knowledge is very essential to deal with the environment effectively and efficiently. Observation and its accuracy are influenced by many subjective and objective factors, such as complexity of the environment, age, sex, attitude, physical and mental conditions at the time of observation, intelligence, etc. This observation differs from individual to individual and from time to time. Description of the environment or the situation observed depends upon memory and language in addition to observation. The accuracy of observation and consequent description or report etc., can be demonstrated in the laboratory by experiments.

### EXPERIMENT NO.1. DIRECTED OBSERVATION AND REPORT

Experimenter :

Date :

Subject :

Time :

*Problem :* To study the effect of directed observation on the accuracy of report.

*Materials :* 1. A picture with many details, mounted on a card-board and covered with a flap.

2. A list of 30 questions, based on the picture and a key with answers.

3. A stop-watch, 4. Writing materials.

*Plan :* Conduct the experiment in two series.—Obtain answers for 30 questions before and after knowledge of questions and compare.

*Procedure :* Inform the S to keep ready to observe the picture. With the signal "start", start the stop-watch, and expose the picture for a period of 30 seconds. At the end withdraw the

picture and present the S 30 questions. Request him to answer each question as accurately as possible in one or two words.

In the second series, expose the same picture and follow the same procedure.

Check up the answers of the S in the first and second series and determine the number of correct answers in each series.

*Precaution :* 1. Do not check up the answers soon after the first series but only after the second series :

2. The S should not know that he has to answer the same set of questions twice ;
3. The answers must be very brief ;
4. While answering the questions second time, the S should not consult the first set of answers.

*Results :* 1. Find out the total number of correct answers given by the group in the first and second series and compute Mean and Range. Also find out the difference between the two sets of scores.

*Table showing the accuracy of report before and after directed observation.*

Sl. No.	Names	No. of correct answers		Difference
		I Series	II Series	
1	A			
2	B			
3	C			
	Sum			
	Mean			
	Mx.			
	Mm.			
	Range			

### Discussion

#### A. Note :

Knowledge of questions directs the observation of the S to the items he has answered in the First series. Naturally the

accuracy of report will be more in the second series than in the first series. Even then individual differences in the accuracy of observation and report are inevitable.

**B. Class Results :**

1. Compare the mean performances of the first and second series. Indicate whether the results are in agreement with the theory or not. Explain.
2. Are there exceptions to the general tendency ? Explain with the help of introspective report of the S or S's.
3. Does the introspective report corroborate with your explanation ?
4. Are there individual differences, age differences, sex differences in the accuracy of report ?

**C. Conclusions :**

1. What is the effect of knowledge of questions on the accuracy of report ? Does the group results agree with theory ?
2. Are there exceptions ?
3. Are there individual differences and sex differences ?

## EXPERIMENT NO. 1. VOLITION AND FLUCTUATIONS

Experimenter :

Date :

Subject :

Time :

*Problem : To study experimentally the effect of volition or Will on fluctuations of attention.*

*Materials : 1. A double perspective book figure ;*

*2. Stop-watch ; 3. Writing materials.*

*Plan : Conduct the experiment in three series—(1) with passive or neutral attitude ; (2) positive attitude and (3) negative attitude. Compare the number of fluctuations of the three series with each other.*

*Procedure : Before conducting the experiment show the double-perspective book figure and find out whether he sees the figure once as half-opened and another time as half-closed book. Tell him the shift from one meaning to the other in the same figure is known as fluctuation.*

*With this arrangement conduct the experiment in 3 series.*

*I Series—Neutral Attitude : Tell the S. : "I will show you a double perspective book figure. It appears once as half opened and another time as half closed book to you. You look at the figure with neutral attitude. While observing it, your attention oscillates between the two meanings. The oscillations in double perspective book figure are due to fluctuations of attention. Neither try to get fluctuations nor resist fluctuations. If they occur voluntarily note down in your book by putting a dot for every fluctuation. While noting down do not withdraw your attention from the book figure.".*

With these instructions, say 'start', start the stop-watch and expose the double perspective book figure. Allow 30 seconds to observe. At the end withdraw the figure. Note down the number of fluctuations.

*II Series—Positive Attitude* : Tell the 'S' to assume positive attitude i.e., try to get as many fluctuations as possible. Then expose the figure and follow the procedure as above.

*III Series—Negative Attitude* : Tell him to resist occurrence of fluctuations to the extent possible and if they still occur note down. Then do as above.

*Precautions* : 1. There should be no distractions around.

2. The S should not withdraw his attention from the book figure to note down fluctuations.

3. Each attitude must be strictly assumed by the S.

*Results* : 1. Find out the difference in the number of fluctuations between neutral and positive, neutral and negative attitude series.

2. Calculate Mean and SD for the group in each series.

*Table showing the number of fluctuations under neutral, positive and negative attitudes.*

Sl. No.	Name	No. of fluctuations—under			Difference	
		neutral attitude	Positive attitude	Negative attitude	neutral- positive	neutral- negative
1	A					
2	B					
3	C					
	Total					
	Mean					
	SD					
	CR/t					

### Discussion

#### A. Note :

The number of fluctuations is more under positive attitude less under negative attitude and moderate under neutral

attitude. This indicates that 'will' has certain amount of control over fluctuations. Individuals differ widely in the strength of *will* and consequently in the number of fluctuations.

**B. Class results :**

1. Does the group agree with theory ?
2. Are there exceptions ? and why ?
3. Are there individual differences ? If so, where it is more ?
4. Are there sex differences ?

**C. Conclusions :**

1. Is there any effect of Will on the number of fluctuations?
2. Is it possible to attend without fluctuations ?
3. Do individuals differ ? Does sex differ in the number of fluctuations ?

## EXPERIMENT NO. 2. DISTRACTION OF ATTENTION

Experimenter :

Date :

Subject :

Time :

**Problem :** To determine experimentally the effect of auditory distractions (a) noise and (b) music, on efficiency of work.

**Materials :** 1. Adding sheets ; 2. stop-watch ;  
3. buzzer; 4. record player and 5. writing materials.

**Plan :** Conduct the experiment in two parts. Part I. without distractions. Part II. with distractions. Second part in 2 series. (a) with noise of the buzzer and (b) with the music of record player. Compare the performances of the two parts with each other.

**Procedure :** Conduct the experiment in two parts :

**Part I without distractions :** Tell the S "I will give you an adding sheet. It consists of several rows of numerical units. Each unit consists of 6 digits. You have to find out the correct total of each unit and write the total {below the unit. Thus find the total of as many units as possible."

With the above instructions, say "start" start the stop-watch simultaneously. Allow 5 minutes to do the work. At the end with the signal 'stop', underline the last unit totalled up by the S

**Part II : I Series : Noise :** Tell the S that at the signal 'start', he has to start doing the something from the unit next to the one underlined last. Allow 5 minutes to do the work. While the S is doing the work cause the buzzer sound intermittently.

**II Series-Music :** Follow the same procedure but while the S is doing the work, start the record player. Time allowed is 5 minutes.

**Precautions :** 1. Totalling of the units should be done either columnwise or row-wise;

2. To avoid monotony or boredom allow 5 minutes rest in between the parts and series.

3. Distractions introduced must be intermittent and not continuous and it must be sufficiently strong.

**Results :** 1. Find out the number of units correctly totalled in each series;

2. Find out the difference between without distraction and noise, without distraction and music and between noise and music.

3. Compute Mean, SD and significance of the difference.

*Table showing the number of units correctly totalled in three Series.*

Sl. No.	Name	No. of units correctly totalled			Difference Between		
		Without distraction	With noise	With music	Calm-noise	Calm-music	Noise-music
1	A						
2	B						
3	C						
	Total						
	Mean						
	SD						
	CR/t						

### Discussion

#### A. Note :

Distraction whatever be its nature affects the efficiency of the work adversely. Of the two types of distractions music has greater distracting effect than noise. If the distraction is continuous even though it is intense the S will adjust to it with lapse of time. If distraction were to be effective it must be intermittent. In some cases the S overcomes distraction at the cost of extra energy. Music at times, if it agrees with the rhythm of the work, facilitates efficiency in work. Quite a lot of work is done on distraction in the field of industrial psychology.

#### B. Class Results :

1. Where the work is adversely affected ?
2. What type of distraction is more effective ?
3. Does the group result agree with the theory ? Explain
4. Are there exceptions to general tendency ?
5. Are there individual differences ? Sex differences ?
6. What are the factors which contribute to individual differences ?
7. Are the differences significant ?

#### C. Conclusions :

1. What is the effect of distraction on the performance ?
2. What type of distraction is more effective ?
3. Are there exceptions ? Individual differences ?
4. What is the application value of this experiment ?

(Note : If one of the forms of distraction is omitted, the problem will be *distraction on the efficiency of work*)

### EXPERIMENT NO. 3. DIVISION OF ATTENTION

Experimenter :

Date :

Subject :

Time :

*Problem :* To find out the possibility of division of attention between-(a) two muscular tasks, (b) two mental tasks and (c) one muscular and one mental tasks.

*Materials :* 1. A stop-watch ; 2. writing materials ;

3. Division of attention board with circular and triangular grooves ; 4. two stylus, 5. two electromagnetic counters; 6. two battery boxes.

*Plan* : Conduct the experiment in three parts i.e.,

1. two muscular tasks;
2. two mental tasks and
3. one muscular and one mental tasks. Each part to be conducted in three series. Compare the indices of the three parts with each other.

*Procedure* : Before giving the experiment, connect one of the terminals of the division of attention apparatus to the counter, counter to battery and battery to stylus. Similarly, connect the other terminal of the division of attention apparatus to another counter, battery and stylus. This is necessary to record the number of times each pattern is traced.

#### *Part I-Two Muscular Tasks*

*I Series-Muscular Task No. 1* : Instruct the S, that at the signal 'start' to start tracing the 'triangular pattern' of the division of attention board with metallic stylus, as fast as possible in his right hand. With this instruction, give the signal 'start' and start the stop-watch simultaneously. Allow 30 seconds to do the work. At the end say stop and note down the number of times triangle is traced as read in the counter. This is  $S_1$  (single muscular task number 1).

*II Series : Muscular task No. 2* : Now, tell the S to trace the 'circle' in the left hand. Time allowed and procedure to be followed is the same as above. Note down the score. This is single muscular task number 2. ( $S_2$ )

*III Series : Two muscular tasks* : Instruct him to trace 'triangle' in the right hand and 'circle' in the left hand simultaneously, at the signal 'start'. Time allowed is 30 seconds. Note down the number of triangles separately and circles separately. Here tracing triangle is 'double task number 1 ( $D_1$ )' and circle is double task number 2 ( $D_2$ )

From the above scores, calculate the index of divisibility by applying the following formula :

$$\text{Index of divisibility (I.D)} = \frac{D_1 + D_2}{S_1 + S_2}$$

### Part II—Two Mental Tasks :

*I Series—Mental Task No. 1 (S<sub>1</sub>)* : Instruct S to start writing the alphabets in the reverse order i.e., Z to A, at the signal start. Time allowed is 30 seconds. At the end find out the number of alphabets correctly written. This is single task number 1 (S<sub>1</sub>).

*II Series—Mental task No. 2 (S<sub>2</sub>)* : Give the S a number, say '5'. Tell him to treat it as *base number*. Then give him another number say '4'. Tell him this is *given number*. Instruct him to go on adding the given number to the base number loudly at the signal start. He has to add the given number to every succeeding total i.e.,  $5+4=9+4=13+4=17$  etc. Time allowed is 30 seconds. The number of times the given number is added to the base number in the given period constitutes S<sub>2</sub>.

*III Series—Two Mental Tasks* : Give him a *base number* and a *given number*. Tell him that at the signal 'start', he should start writing the alphabets in the reverse order. At the same time to go on adding the given number to the base number as fast as possible orally. Allow 30 seconds. Here the alphabets written constitute D<sub>1</sub> and adding constitutes D<sub>2</sub>. Applying the previous formula, calculate index of divisibility between two mental tasks.

### Part III—One Physical and One Mental Tasks :

*I Series—Physical Task* : As the score is available, take score of I part II Series i.e., tracing circles in the left hand (S<sub>1</sub>).

*II Series—Mental Task* : Take the scores of II Part I series i.e., number of alphabets in the reverse order (S<sub>2</sub>).

*III Series—One physical and One Mental tasks* : Instruct him to trace circles in the left hand and to write the alphabets in the right hand in the reverse order. Here tracing circles is D<sub>1</sub> and writing alphabets is D<sub>2</sub>. Calculate the index of divisibility as above.

*Precautions* : 1. Adding should be sufficiently audible to the experimenter and mistakes should be noted by experimenter ;

2. Adding the numbers and writing the alphabets must be done as accurately as possible.

**Results :** 1. Calculate index of divisibility or coefficient of division for each part and compare;

2. Calculate the Mean, Median and Q to indicate dispersion.

*Table showing the indices of divisibility between two tasks :*

Sl. No.	Name	Index of divisibility between		1 muscular and 1 mental task
		2 muscular tasks	2 mental tasks	
1	A			
2	B			
3	C			
	Total			
	Mean			
	Mdn			
	Q			

### Discussion

#### A. Note :

Maximum index of divisibility is 1.0. This indicates that division of attention is perfect. Unfortunately, such perfect division of attention between two tasks of any nature or character is generally not possible. If there is any, it is only an exception. Though perfect division of attention is not possible, to some extent we can attend two tasks. Even this is not division of attention in the strict sense, rather it is quick oscillation of attention between the two tasks. Generally, division of attention results either in the loss of quantity or quality or both of the work. However, the so-called division of attention is apparently possible under the following conditions; (1) when both the physical or motor tasks are very simple and become automatic (2) when one of the two tasks is physical and becomes automatic and the other is mental and needs attention. Ex. knitting and talking; (3) when the two tasks are

nothing but the two parts of the same unit. Ex. Pedaling and riding bicycle.

In the light of the above, index of divisibility is large if two tasks are physical and simple, moderate if one is physical and another is mental, and least if both are mental in nature.

**B. Class Results :**

1. Where do you find the index of divisibility is highest ? and where it is lowest for the group ?
2. Do the group results agree with the theory ?
3. Are there exceptions to group tendency ?
4. Are there individual differences in index of divisibility ?
5. Are there sex differences ?
6. where do you find the dispersion is large and where it is least.

**C. Conclusions**

1. Can attention be divided perfectly between two tasks ?
2. What is the relation between the nature of the task and loss of efficiency ?
3. Do individuals differ ? Does sex differ ?
4. Are there exceptions to the general tendency ?
5. What is the practical application value of this experiment ?

## EXPERIMENT NO. 6—MEANING &amp; SPAN OF APPREHENSION

Experimenter :

Date :

Subject :

Time :

*Problem* : To study the effect of introducing meaning into the material on visual span of apprehension.

*Materials* : 1. Techistoscope with camera slit to expose the material for 1/10 of second.

2. Two sets of cards. Set I contains nonsense combinations of letters ranging from 3 to 9. This set will have 7 subsets of 4 cards in each i.e., 28 cards in total. Subset one has 4 cards of letters in each with different combinations. Subset two has 4 cards of 4 letters in each etc. Set II consists of words ranging from 3 to 15 letters. Thus there are 13 subsets of four cards in each and in total 52 cards with a meaningful word in each.

*Plan* : Conduct the experiment in two series i.e., with non-sense combinations of letters and with meaningful words. Compare the spans of the two series with each other.

*Procedure* : I Part—Non-sense Combinations of letters : Make the S to sit in such a way that he can easily and clearly see the letters through the slit when exposed. Then instruct the S thus: "You keep on observing the slit attentively. With the signal ready, I will expose a card with letters through the slit for a short period. Write down the letters observed in the same order. After exposing all the four cards, I will read out the letters of each card. You check up your answers and assign '1.0' mark to every right letter in the right place and 0.5 to right letter in a wrong place".

Then you find out total marks for that subset. Thus follow the same procedure regarding the other subsets. If the S fails to obtain lesser than 75% of the total marks in two consecutive subsets stop the experiment.

II Series—Meaningful Words : Follow the procedure as above, using the cards with a meaningful word in each.

*Precautions* : 1. The same as the previous experiment.

*Results* : 1 Determine the threshold for the S and for the

group for non-sense and meaningful materials separately.

2. Compute Mean and SD for the group and compare.

*Analysis of the cards :*

No. of letters	3	4	5	6	7	8	9	10	11	12	13	14	15
No. of cards	4	4	4	4	4	4	4	4	4	4	4	4	4
Mx. Marks	12	16	20	24	28	32	36	40	44	48	52	56	60
75% of the max.	9	12	15	18	21	24	27	30	33	36	39	42	45

3

*Table showing the span of apprehension for non-sense syllables and meaningful words.*

Sl. No.	Names	Span for		
		Non-sense syllables	Meaningful words	Difference
1	A			
2	B			
3	C			
	Total			
	Mean			
	SD			

### Discussion

#### A. Note :

Generally, span of apprehension is larger for meaningful combination of letters (words) than for non-sense syllables. It increases with meaning. Just as span of attention, span of apprehension also varies from individual to individual and age to age (upto a particular age). Span of apprehension is more than span of attention. It depends upon the following factors. (1) Grouping and organisation; (2) constant interval between the ready signal and the exposure of the stimulus; (3) richness of meaning; (4) distance (5) pre-exposure and post-exposure field which provides positive after image; (6) practice and (7) age

**B. Class Results :**

1. What is the group span for non-sense syllables and for meaningful combinations of letters ?
2. Does your group agree with the general tendency ?
3. Are there exceptions to this general tendency ?
4. Are there individual differences ? age differences ? and sex differences ?
5. What does SD reveal ?
6. What is the relation between your results and the accuracy and speed with which different types of printed matter can be read ?
7. Are your results related to the proof readers illusion ? Overlooking of typographical errors in reading— see Munn—Psychology—under heading 'Reduced Cues.'

**C. Conclusions :**

1. Is there any relationship between span of apprehension and meaning ?
2. Do individuals differ ? Are there sex differences ?
3. What is the application value of this experiment ?

## EXPERIMENT NO. 3 WORD BUILDING TEST

Experimenter :

Date :

Subject :

Time :

*Problem : To study the effect of systematic procedure on lingual imagination by word building test.*

*Materials : 1. Two sets of six letters (English alphabets.) Each set will have 3 vowels and 3 consonants. 1) Set—AEO MBT, 2) EAIRLP*

*2. stop-watch and 3. Writing materials*

*Plan : Conduct the experiment in two series. i.e., (1) Random method (2) Systematic method. Compare the number of words constructed in the two series with each other.*

*Procedure : I Series—Random Method : Place before the S, the first set of six letters and instruct him thus: At the signal 'start', using these six letters, construct as many words as you can. While constructing you must bear the following instructions in mind.*

*1. Each word must be made up of atleast three letters. 2. The same letter should not be used more than once in the same word. 3. Letters other than the given ones should not be used to construct words. 4. The word should not be a proper name or abbreviation." Allow 5 minutes to construct the words.*

II Series—Systematic Procedure : Present the second set of six letters to the S. Instruct him thus : "You have to construct as many words as possible using these six letters. While constructing you have to satisfy one more condition in addition to the above four conditions i.e., take the first letter of the set and write all the possible words starting with it. Then take the second letter and write all the possible words starting with it. Follow the same procedure with respect to the remaining letters." Allow 5 minutes to write words in this case too:

*Precautions : Before giving the experiment proper, give trials with another set of six letters and make sure that the S has understood the instructions.*

*Results : 1. Find out how many words are constructed under random method satisfying the conditions,*

2. Find out how many 3 lettered, 4 lettered, and six lettered words are constructed.
3. Do the same things with respect to the results under systematic procedure.
4. Calculate Mean, SD and significance of the difference between the two performances.
5. Find out the relationship between word building test and visual imagination test (Rho).

Table showing the number of words constructed under Random and Systematic Procedures and statistical measures.

Name	1. Random method-			2. Systematic method-		
	Total No. of words	No. of words under		Total No. of words	No. of words under	
A		3 lettered words			3 lettered words	
B		4 lettered words			4 lettered words	
C		5 lettered words			5 lettered words	
Total		6 lettered words			6 lettered words	
Mean						Dif. between the two methods in the total no. of words
Sd						
Cr/t						

**Discussion****A. Note :**

1. Though at the outset random procedure offers freedom to construct any word in any order, generally systematic procedure facilitates creative imagination more than the random procedure. The reason is that systematic procedure makes the S to think in a particular direction, which is lacking under random procedure.

2. Generally, 3 and 4 lettered words are more than 5 and 6 lettered words ;

3. As both the tests are intended to measure the same ability, we expect the correlation to be positive and highly significant.

**B. Class Results :**

1. In which series is the number of words constructed more?
2. Is the difference between the two methods significant?
3. How many lettered words are more in each series?
4. Does your group agree with the general tendency?
5. Are there exceptions to the general tendency?
6. Do you find individual differences? Sex differences?
7. What is the relationship between word building test and ink-blot test?
8. What is the application value of this experiment?

**C. Conclusions :**

1. Which of the two methods facilitates creative imagination better?
2. What length of words is more frequent?
3. Do individuals differ? Sex Do differ in creative imagination?
4. What does the correlation reveal?

## EXPERIMENT NO. 2 HORIZONTAL-VERTICAL ILLUSION

Experimenter :

Date :

Subject :

Time :

**Problem :** To study the effect of change in the method of presentation on the extent of horizontal-vertical illusion.

**Materials :** 1. Horizontal-vertical illusion board, in which the vertical line joins the horizontal line exactly at the centre and stands at 90°.

2. Metre scale; and 3. Writing materials.

**Plan :** Conduct the experiment in two series. (1) Ascending method (2) Descending method. Compare the extent of illusion of the two series.

**Procedure : I Ascending Method :** Before giving the experiment, hold the length of the vertical line definitely shorter than the horizontal line. Show it to the S and ascertain whether the vertical line appears definitely shorter than the horizontal line. Here treat the horizontal line as standard line. Hold the length of it constant. Treat the vertical line as variable line and vary the length of this line depending on the need. With the above arrangements instruct the S thus : Now I will hold before you a horizontal vertical illusion board. Keep on observing the point at the juncture (place where vertical line joins the horizontal line) of the line. I will gradually increase the length of the vertical line. When it appears equal to the horizontal line tell me to stop. I will stop increasing the length.

With the above instruction, say start and start increasing the length until the S says stop. Note down the length of the vertical line adjudged equal to the standard line. The difference is illusion.

**II—Descending Method :** Hold the length of the vertical line

definitely longer than the horizontal line. Tell him : I will gradually decrease the length of the vertical line. Keep on observing as you did before and report when it appears equal to the horizontal line. Then follow the procedure as above.

Determine the extent of illusion, overestimation and underestimation as done in the previous experiment.

**Precautions :** 1. The distance between the S and the board must be constant.

2. The rate of increasing or decreasing the length of the variable line should be constant.

3. The S should avoid movement of the eye but keep on observing the point at the juncture of the two lines.

4. The S should report when the variable appears equal to the standard but should not postpone judgement, though it appears equal or should not give judgement even before the variable appears equal.

**Results :** 1. Calculate Mean and SD for the group in the magnitude of illusion in the ascending and descending method separately.

2. Calculate the significance of the difference between the two means.

3. Calculate the extent of overestimation and underestimation.

4. Find out the difference in the extent of illusion between the two series for each S and to the group.

*Table showing the magnitude of illusion in the ascending and descending methods and statistical measures.*

Names	Magnitude of illusion in		
	Ascending method	Descending method	Difference
A			
B			
C			
Total			
Mean			
SD			
CR/t			

## Discussion

### A. Note :

1. Generally, the vertical line by virtue of its position looks longer than the horizontal line of equal length. This is because the movement of the eyes along the vertical line is more strenuous than the movement on the horizontal line. The eyes have to move against the gravitational pull, and hence experience strain. This causes the feeling that it is longer than what it is.

2. Several objective factors contribute to horizontal-vertical illusion, such as (a) colour of the lines; (b) angle of the vertical line with reference to the horizontal line; (c) length of the two lines; (d) thickness of the horizontal line; (e) thickness of the vertical line; (f) duration of exposure of the lines; (g) rate of increasing or decreasing the length of the vertical line; (h) fixation of the eye; (i) gap at the juncture. Apart from these objective factors many subjective factors, such as (a) social facilitation, (b) age, (c) practice, also contribute to horizontal-vertical illusion.

3. Change in the method of presentation causes some change in the direction and the extent of illusion;

4. Generally, there will be underestimation of the standard line and overestimation of the variable line.

### B. Class Results :

1. What is the magnitude of illusion in each series ? Is the difference between the two significant statistically ?
2. What is the direction of illusion in each series ?
3. Is there any effect of change in the method of presentation on the magnitude of illusion ?
4. Do the results of your batch agree with the general tendency and the studies in the past ?
5. Are there exceptions to general tendency ? Explain.
6. Are there individual differences ? age differences and sex differences ?
7. What are the factors that contribute to the above differences ?

## 8. What is the application value of the experiment ?

### C. *Conclusions :*

1. Is illusion a normal and universal phenomenon ? are there any exceptions ?
2. Does change of method cause any change in the extent and direction of illusion ?
3. Are there individual differences ? age differences ? sex differences ?

### *Supplementary problems :*

1. Effect of varying the colour, angle, thickness, gap of the arrow and feather heads on Muller-Lyer illusion.
2. Effect of varying colour, angle, thickness, gap, position of the lines on horizontal-vertical illusion.

## EXPERIMENT No. 5 PRINCIPLES OF GROUPING AND ORGANIZATION

Experimenter :

Date :

Subject :

Time :

*Problem* : To demonstrate experimentally the principles of grouping and organisation and to determine relative strength of each principle, such as (a) similarity (b) proximity (c) direction (d) closure and (e) inclusiveness.

*Materials* : 1. A pure white card board with the design showing the principles : 2. Stop-watch ; 3. Writing materials.

*Plan* : Expose the figure to the S for 120 seconds. Note down the number of times each alphabet is perceived by the S and determine the relative strength of each principle.

*Procedure* : Seat the S comfortably on a chair. Then instruct him thus : "With the signal 'start', I will expose a figure to you. Keep on observing it and tell me the different letters (alphabets) you will see in the figure, until you are asked to stop. Each Letter may occur more than once and you have to tell it aloud every time it occurs. Ex. A letter "X" may appear first then "Y" may appear and X may reappear."

With the above instructions and with the signal 'start' expose the figure and keep it before him at a distance of 2 feet. Allow 2 minutes. Note down the letter or letters read out by the S in the same order. At the end of 2 minutes, say 'stop' and withdraw the figure.

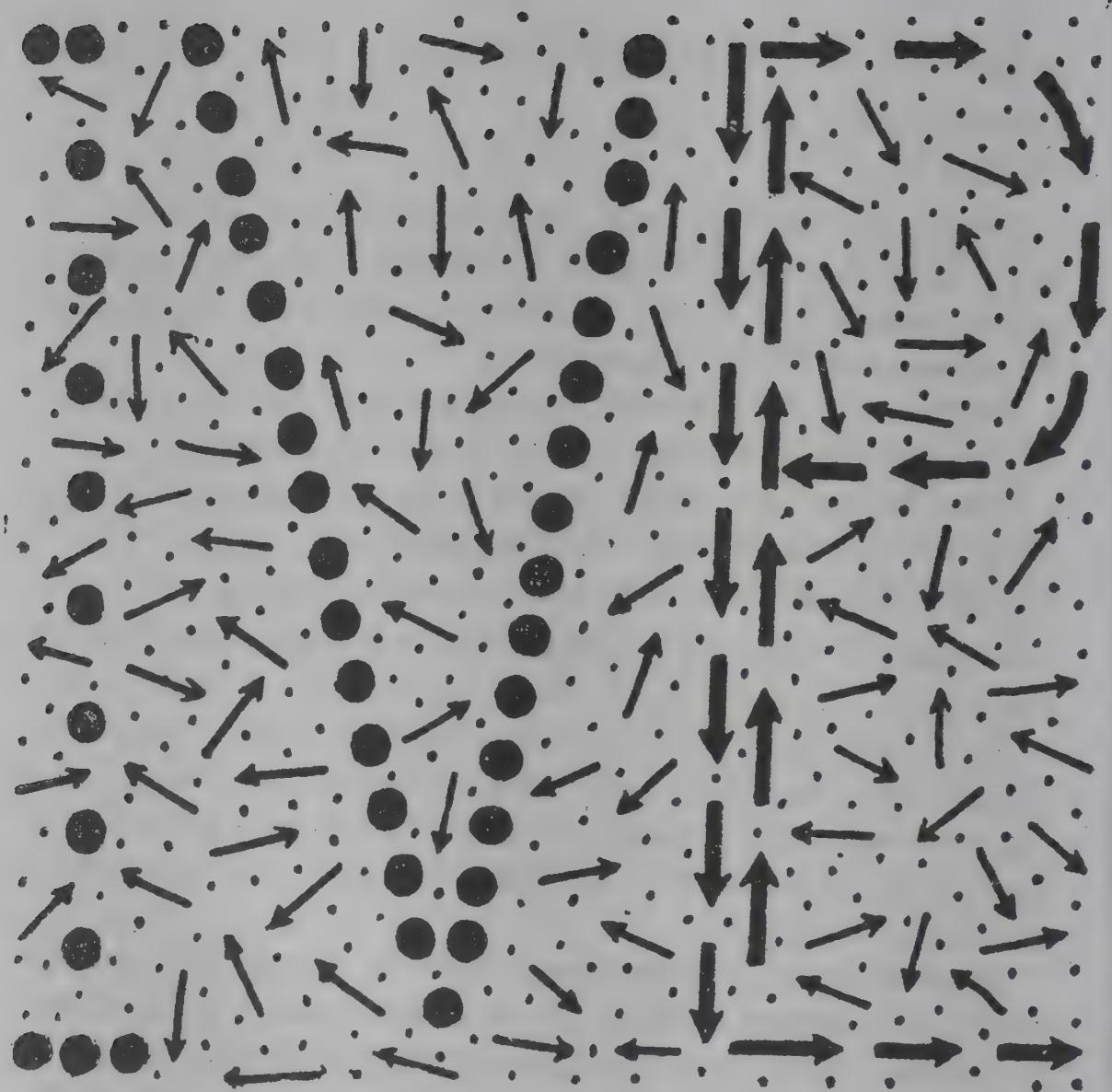


Figure for grouping and organization

*Precautions* : 1. The test must be given in a well-lighted room. Care is to be taken to see that the shadow of the S or the experimenter does not fall on the figure.

2. S should not withdraw his attention from the figure to note down the letter perceived. This is to be done by the E.

3. Before giving the experiment, give examples to make clear the principles of grouping and organization.

4. S should avoid critical or analytical attitudes.

*Analysis of the responses* :

1. If the S perceives merely a group of zeros and a group of arrows it indicates grouping—

2. Perception of letter or letters is an indication of organization. Again (a) perception of letter 'I' refers to principles of similarity ; (b) perception of letter 'V' refers to proximity ; (c) perception of letters 'L' and 'P' refer to principle of direction. (d) Letter 'M' indicates principle of inclusiveness. (e) Letter N indicates closure.

*Results* : 1. Find out how many times each letter is perceived and classify them according to the principles.

2. Determine the principle on the basis of frequency.

3. Determine the relative strength of each principle.

4. Compute Mean and SD for each principle of the group.

5. Find out how many times only zeros and arrows are perceived.

*Table showing the frequency with which each principle has operated with the S and the group*

Name	Number of times each principle has operated in 120 seconds				
	Similarity	Proximity	Closure	Direction	Inclusiveness
A					
B					
C					
Total					
Mean					
Sd					

**Discussion****A. Note :**

When a number of stimuli confront the vision simultaneously, they will not be perceived in unorganized way but in an organized form. Organization of perceptual stimuli into some meaningful form or pattern is governed by certain principles such as similarity, proximity, direction, closure and inclusiveness. Which principle is more predominant than the other and what principle is least predominant is rather disputable. The relative importance depends upon the nature of the material, the attitude and past experience of the S. Sometimes similarity may outweigh proximity, sometimes proximity may outweigh similarity.

**B. Class Results :**

1. Do your group results indicate the principles of grouping and organization?
2. What principle of organization is more predominant in your group results? and which is least predominant?
3. Are there individual differences? under what principle the deviations are more? Are there sex differences?
4. What is the application value of the experiment?

**C. Conclusions :**

1. Is perception without grouping and organization possible?
2. What principle is most predominant and what is least predominant with the group?
3. Are there individual differences? sex differences?

(Note : Material and Procedure are of the author's own).

## EXPERIMENT NO. 3 BILATERAL TRANSFER OF LEARNING

Experimenter :

Date :

Subject :

Time :

*Introduction* : We have experienced that learning of one skill often influences learning another skill. The influence may be sometimes facilitating and sometimes hindering. If the learning of one skill facilitates learning of another skill we call it *positive transfer* or *transfer of training* or *transfer of learning*. Example : A man who has learned to drive a car can drive a similar car almost as well without additional practice. On the other hand, if learning of one skill interferes with or hinders the learning of another skill, we call it *negative transfer* or *habit interference*. Example : A man who has learnt to type on a special kind of key-board finds it more difficult to learn to use a standard key-board.

Transfer takes place (positive transfer) within the same class, Example : learning mazes, word lists, poetry, etc., usually, affects favourably the learning of other samples of the same kind of material.

Bilateral transfer or cross education is another form of positive transfer of learning in which learning in one part of the body facilitates learning in another part of the body. For example : learning to trace the star pattern in the right hand facilitates learning to trace the same pattern in the left hand.

Another form of transfer is the transfer from one class to another. Here the transfer effect is very little. The findings in this field are of immense value for *formal discipline*.

Transfer of training whether it is motor or verbal learning takes place subjected to certain conditions. Such as similarity of contents, similarity of techniques, similarity of principles and a combination of all these.

The studies in this line have high application value in the field of education to develop educational pattern.

*Problem* : To determine the effect of practice in the right hand on the performance in the left hand. OR

To demonstrate the phenomenon of the bilateral transfer by the *fore and after* technique.

*Materials* : 1. Mirror tracing board; 2. Battery; 3. Impulse counter; 4. Stylus and 5. Writing materials.

*Plan* : Give one trial to trace star pattern in the left hand, then six trials to the right hand and again another trial to the left hand. Compare the performance of the left hand before and after training to the right hand.

*Procedure* : Connect the mirror tracing board, battery, impulse counter and stylus in such a way that the counter clicks and records the error when even the stylus contacts the metallic plate of the star pattern. Fix the screen in such a way that the S can see the star pattern in the mirror but not directly.

*I Series—Left Hand—Before training* : Seat the S before the mirror tracing board. Keep the point of the stylus which is in the left hand of the S, at some point on the star pattern. Ascertain whether he sees the star pattern and the stylus on the groove of the star pattern. Then instruct him thus : "At the signal start, start tracing the pattern with stylus without touching the edges (without contacting the plate), as fast as possible until you reach the starting point." With this instruction, give the signal start and start the stop watch. Note down the time taken and errors committed to trace the pattern in the left hand.

Then give him six trials to trace the star pattern in the right hand. Note down the time taken and the errors committed in each trial.

*II Series—Left Hand—After training* : Following the same



### Discussion

According to the literature available in the field that practising an activity with a particular part of the body usually facilitates performance of the same activity with another part of the body. This is technically known as *cross education*. Usually, positive transfer effect is found between symmetrically located parts of the body, from eye to eye, from hand to hand and from foot to foot. If the cross education is from one body organ to its symmetrical counterpart, we call it as *bilateral transfer*. In the present experiment the task is perceptual motor activity. It remains constant throughout but the body parts with which it is performed varies.

The results of cross education experiments uniformly show positive transfer effects. The advantages or disadvantages resulting from transfer are confined to the early parts of the after test. Gradually, the controlled group makes appropriate adjustment and catches up the experimental group which shows transfer effect at early stages.

Munn quotes a study in which the controlled group dropped 55 per cent of errors, whereas the experimental group showed 76 per cent drop after training in the right hand. Thus, we find the difference of 21 per cent in favour of experimental group. Regarding the time scores the controlled group dropped 46 per cent and the experimental group dropped 82 per cent. Even here the difference of 36 per cent is in favour of experimental group.

The magnitude of transfer depends upon the body parts, age, intelligence and eye-hand co-ordination, in addition to the bases of transfer.

#### B. *Class Results :*

1. Compare the performances of the left hand before and after training in the right hand.
2. Do you find that the results of your group agree with the theory ?
3. What is the amount of learning in the right hand ?
4. What is the amount of transfer of training ?

5. Are there exceptions to the general tendency ?
6. Are there individual differences ? sex differences ?
7. What are the factors which cause individual differences ?  
explain on the basis of the introspective report.

**C. Conclusions :**

1. What is the effect of training to the preferred hand on the unpreferred hand ?
2. Are there exceptions to general tendency ?
3. Are there individual differences ?
4. What is the application value of this experiment ?

*Application value :* The findings in this field are of immense value for formal discipline.

**Supplementary problem :**

1. Transfer in verbal learning.

## **EXPERIMENT NO. 7. MASSED VS. SPACED LEARNING**

**Experimenter :**

**Date :**

**Subject :**

**Time :**

***Introduction :*** We have seen students spending their time in the beginning of the year leisurely and at the end of the year try to learn a lot of things in a short time. Consequently, they either get less marks or fail or find it very difficult to remember what they have read in a short period and thus become scared of the examination. But every time when they experience the stress and strain of heavy work, they

resolve to begin their study from the beginning of the year in future. But again they do the same thing next year. Instead of this, if they could plan their studies from the beginning of the year, they do not feel the burden of work and avoid stress and strain at the time of examination, learn things better, and get good results in the examination.

In this connection psychologists have found out how uneconomical and a waste is unspaced method of study and on the other hand how economical and serviceable is the spaced method of study. Quite a large number of psychologists have advocated the spaced method of study as economical. They have found from their studies that the longer the rest period between learning, the better will be learning. They have offered many explanations in support of their findings.

*Problem* : To determine the relative merits of spaced and unspaced methods for learning verbal material. OR to find out the effect of distribution of learning periods on retention.

*Materials* : 1. Stop-watch; 2. Writing materials and 3. Two lists of words (A & B) containing 20 words in each.

*List A*

1. College
2. Pencil
3. Water
4. Elephant
5. Bottle
6. Friend
7. Quarrel
8. Student
9. Medicine
10. Power
11. Photo
12. Picture
13. Security
14. Woman
15. Cover
16. Postage
17. Memory
18. Seconds
19. Learn
20. Dolls

*List B*

1. Teacher
2. Escape
3. Eating
4. Talking
5. Accident
6. Husband
7. Business
8. Daughter
9. Founder
10. Procedure
11. Retention
12. Absurd
13. Errors
14. Space
15. Merit
16. Repeat
17. Stars
18. Temple
19. Chair
20. Books

*Plan* : Conduct the experiment in two series-Mass (Unspaced) method and spaced method. Present the list five times in each series orally and compare the number of words correctly learnt in each series.

### *Massed Method—List A*

**Procedure :** Seat the S comfortably and tell him thus : I will present you orally a list of words five times. At the end, I will give you a few simple multiplication problems. Solve them as quickly as possible. Then try to reproduce the words read out to you as accurately as possible".

With these instructions say "Ready", start the stop-watch and start reading out loudly the words from the list A simultaneously. Read out at the rate of 2 seconds a word. After reading out the list once allow five (5) seconds interval to read the list again. Thus present the list five times, with an interval of 5 seconds in between the presentation of the list. After 5th presentation, allow 60 seconds interval during which give the S a few sums (simple) to do. This is known as distraction period. Soon after this distraction ask the S to reproduce the list. The total amount of time spent for learning is 200 seconds i.e., 40 seconds per presentation of the list.

**Distribution Method (Spaced Method)—list B :** Holding all other things constant, present the words from List B orally at the rate of 2 seconds a word and 5 seconds interval between two readings. At the end of second presentation, introduce 5 minutes distraction period. Then present the list twice again as before and give 5 minutes distraction period. Finally, present the list once again and allow 60 seconds distraction. Then ask the S to reproduce the list. Here also total time spent for learning is  $80 + 80 + 40 = 200$  seconds.

**Precautions :** 1. The time spent on learning under both the methods should be the same leaving apart the interval and distraction periods.

2. During distraction the S should be given some multiplication problems to avoid recalling the words during the period.

3. The rate and tone of presentation must be constant.

**Results :** 1. Find out the number of words learnt correctly in each series by the S.

2. Calculate Mean, SD, SE and CR/t for the group scores.

3. Find out the difference between the two sets of scores for each S and the group.

*Table showing the number of words learnt correctly in each list under two methods*

Sl. No.	Names	Number of words learnt under		Difference
		Massed Method	Spaceed Method	
1	A			
2	B			
3	C			
	Mean			
	SD			
	SE			
	CR/t			

### Discussion

#### A. Note :

According to theory spaced method is more economical and advantageous for learning than Mass method. Again between the work unit i.e., the amount of work per unit and rest unit (the length of rest) the work unit is more significant than rest unit. However, holding the work unit constant if the rest unit is increased, efficiency increases. Further, it is found that the most effective units of work and rest depend upon the task and the S.

The reasons for distributed (spaced method) method being more economical and advantageous are (1) Increased work unit causes fatigue. This in turn affects learning adversely. So short work unit and long rest unit help to overcome fatigue and cause better motivation to learn. (2) Rest unit facilitates consolidation and perseveration of neural processes caused by our activities. (3) Natural resistance for repetition of an act can be avoided by spaced method. (4) During rest period under spaced method errors will be dropped out for want of reinforcement.

**B. Class Results :**

1. Under what method the group performance is better ?
2. Is the difference between the two performances significant ?
3. Does your group agree with the theory? If it disagrees —explain.
4. How many are in agreement with the theory and how many are in disagreement with the theory ?
5. Are there exceptions and individual differences ? Explain
6. What is the application value of this experiment ?

**C. Conclusions :**

1. Which method of learning is more advantageous to your group and does it agree with the theory ?
2. Are there exceptions to general tendency ?
3. Are there individual differences ?

*Application Value :* The results of this experiment has a special bearing on the students planning their studies. It helps them to know the futility of trying to learn all the lessons in a short time by continuous sitting.

*Supplementary problem :*

1. Nature of material on the relative advantages of spaced and unspaced methods of learning.
2. Different length of rest interval on learning.
3. Different length of work unit on learning.

## EXPERIMENT NO. 10. KNOWLEDGE OF RESULTS ON LEARNING

Experimenter :

Date :

Subject :

Time :

*Problem* : Determine experimentally the effect of knowledge of results of ones own performance on verbal learning.

*Materials* : 1. Two lists of meaningful words of twenty in each. 2. Stop-watch 3. Writing materials.

*Plan* : Conduct the experiment in two series—1. without the knowledge of results 2. with the knowledge of results. Compare the number of trials required to learn the words under each

series, and determine the importance of knowledge of results on learning.

*Procedure : I Series—Without the knowledge of results—List A*  
 Seat the S on a chair comfortably and instruct him thus : *I will read out a list of twenty words loudly. Listen to me attentively and learn the list. At the end reproduce as many words as you can on a sheet of paper.* With this instruction say ready and start reading the words from the list A at the rate of two seconds a word in an even tone. At the end of the trial allow three minutes to reproduce as many words as he can on a sheet of paper. After writing the words collect the sheet from the S and find out the number of words reproduced correctly but do not inform him the results. Following the same procedure present the list any number of times until the S reproduces the entire list correctly. Note down the number of words reproduced in each trial correctly and the number of trials taken to learn the list.

*II Series—With the knowledge of results—(List B) : Here use the words of the list B and follow the same procedure to present the list, but inform the S his results after each trial. Thus continue the trials until the S reproduces the entire list completely and correctly. Note down the number of words reproduced correctly in each trial and the number of trials taken to learn the list B with the knowledge of results after each trial.*

*Precautions : 1. The length and the difficulty level of each word in both the lists must be constant and meaningful.*

*2. The speed and tone of presentation of each word must be constant and even.*

*3. In the I series do not allow the S to know the result of his own after each trial, but in the II series inform the S after each trial his own performance.*

*4. Do not inform the S the object of the experiment till the end.*

*Analysis of the results : 1. Find out the number of words reproduced in each trial, and in each series by the S.*

2. Present the scores of each trial on a graph to show the effect of knowledge of results.

3. Find out the number of trials taken in each series to learn the list.

4. Work out the group average of the trials under each series.

5. Work out SD, and CR for the mean difference.

*Table 1 showing the number of words reproduced by each S in the I series.*

Names	No. of words reproduced in each trial						Total number of trials taken
	1	2	3	4	5	6 etc	
A							
B							
C							

*Table 2 showing the number of words reproduced by each S in the II series.*

Names	No. of words reproduced in each trial						Total number of trials taken
	1	2	3	4	5	6	
A							
B							
C							

*Table 3 showing the number of trials taken in each series and difference*

Sl. No.	Names	No. of trials taken under		Difference
		without knowledge	with knowledge	
1	A			
2	B			
3	C			
	Total			
	Mean			
	SD			
	CR			

## Discussion

### A. Note :

Studies in this area have revealed that knowledge of results of ones own effort acts as an incentive. It not only promotes learning but also accelerates it. It fills in confidence and offers direction to the S to learn. In the sense it guides him to know how much he has to learn and what he has to learn in each successive trial. Naturally the S pays more attention to what he has to learn in each trial and the S puts forth more efforts to reach the target early. Hence knowledge of results makes learning better and quicker. Consequently the number of words the S learns in each trial will be more and the number of trials required to learn will be lesser. This depends upon age, sex, interest, level of intelligence and aspiration of the S.

### B Class Results :

1. How many trials on the average are required by the group under each series ?
2. Is the mean difference between the two series significant ?
3. Are the group results, in agreement with the theory ?
4. Are there exceptions to the general tendency ? if so, how many ?
5. Are there individual differences in the beneficial effect of knowledge of results ?
6. Are there age and sex differences in the results ?
7. What is the differential trend found in the graphic presentation of the results of each series ?

### C. Conclusions :

1. Is there any effect of knowledge of results on verbal learning ?
2. Are the group results in agreement with the theory ?
3. What does graph reveal ?
4. Are there, age, sex, and individual differences ?

*Application value :* Individual's progress chart and group progress chart, in any area of production and in the educational institutions will have beneficial effect.

believed that with the lapse of time the impression made on the nerve tissues would fade away. This is a very inadequate explanation of forgetting. It is understood from the studies that forgetting is due to interference or obliteration of the old by the new ones. It may also be due to retroactive or proactive inhibitions. The degree of inhibition depends upon the extent of similarity between the old and the new materials, degree of meaning and logical relationship, length of the material, strength of learning the original material and the interpolated activity, alteration in the stimulating conditions, change of set and finally with the desire of the subject (S).

Finally from the results of their studies on memory psychologists have offered a few tips to improve our memory: (1) have intention to learn, (2) pay close attention to what you learn, (3) use imagery to the fullest extent, (4) tie up what you have learned with other things, (5) make use of rhythm which aids retention, (6) distribute your learning to the extent possible (7) rehearse or recite the material wherever possible and, (8) have rest or sleep after learning (study).

Here we are going to demonstrate the methods of recall recognition, distribution etc.

#### EXPERIMENT NO. 1 RETROACTIVE INHIBITION

Experimenter : Date :

Subject : Time :

*Problem* : To demonstrate the phenomenon of retroactive inhibition on recalling verbal material.

*Materials* : 1. Stop watch, 2. Writing materials and 3. Three lists of meaningful words of 20 in each. List B and C are Synonyms.

*List A* : 1. Butterfly, 2. Mountain, 3. Tobacco, 4. Soldier, 5. Material, 6. Sample, 7. Average, 8. Syllable, 9. Economy, 10. Considerable, 11. Accustom, 12. Progress, 13. Selection, 14. Officer, 15. Revenue, 16. Recite, 17. Hungry, 18. Blossom, 19. Scissors, 20. Religion.

*List B* : 1. Niggardly, 2. Nature, 3. Stomach, 4. Cottage,

5. Wonder, 6. Profound, 7. Retreat, 8. Solace, 9. Regenerate, 10. Diminish, 11. Defeat, 12. Abstain, 13. Effect, 14. Hundred, 15. Manner, 16. Leap, 17. Expect, 18. Collect, 19. Beast, 20. Attempt.

*List C* : 1. Stingy, 2. Heredity, 3. Abdomen, 4. Castle, 5. Surprise, 6. Deep, 7. Withdraw, 8. Comfort, 9. Produce, 10. Reduce, 11. Failure, 12. Stubborn, 13. Consequence, 14. Century, 15. Method, 16. Jump, 17. Anticipate, 18. Gather, 19. Animal 20. Effort.

*Plan* : Conduct the experiment in two series. 1. without interpolation and 2. with interpolation. Compare the number of words recalled under two series with each other and determine the extent of retroactive inhibition.

*Procedure* : *I series—without interpolation—(List A)* Seat the S comfortably on a chair. Then instruct him thus *I will present a list of words (20) one by one orally. Listen carefully and learn the list.*

With the above instruction, say *ready*, start the stop watch and present the list orally at the rate of 2 seconds a word. The list requires 40 seconds to read. Thus present the list five times with an interval of 5 sec, in between each presentation of the list. After 5th presentation give 10 minutes rest period during which, either give some multiplication problem or ovals cancellation test so that the S may not recall the list during interval. Then tell the S to reproduce the list.

*II series—with interpolation—(List B)* : Following the same procedure present the list B five times. During the rest pause of 10 minutes, present the list C five times for interpolation. This interpolation covers 220 seconds. For the remaining period (380 sec) assign the S ovals cancellation test. At the end tell the S to reproduce the list B.

Check up the responses with reference to the key.

*Precautions* : 1. During the rest period care should be taken to see that the S does not recall the list.

2. In the second series do not inform the S before hand that

he has to recall only the list B and not C, so that he may pay attention to B and not C. This naturally affects the results.

3. The words must be of equal difficulty in all the three lists. The words of B and C must be similar in meaning or synonyms.

4. Learning period must be constant.

*Analysis of the results:* 1. Find out how many words are reproduced from the list A and B separately and show the difference.

2. Calculate mean, SD and CR for the group results.

*Table showing the number of words reproduced from the list A (before RAI\*) and list B (ARAI\*)*

Names	Words reproduced		Difference
	Before (List A)	After (List B)	
A			
B			
C			
Mean			
SD			
CR/t			

\*BRAI = Before Retroactive inhibition

\*ARAI = After Retroactive inhibition

### Discussion

#### A. Note :

Retroactive inhibition is defined as the adverse effect upon retention of an activity interpolated between learning and recall. It is an example of negative transfer because the learning of one task interferes with the retention of another. From this we understand that time by itself does not affect anything much but the interpolation of an activity causes an adverse effect on retention.

The extent of retroactive inhibition depends upon the following factors.

1. The method of measurement i.e., whether it is the method of recall or relearning or recognition etc.,
2. Similarity between original and interpolated activities. If the original activity is nonsense syllables and the interpolated activity is also nonsense syllables retroactive inhibition is considerably great. On the other hand if the interpolated activity is meaningful RAI is less. If the two activities become more similar and involve more responses in common, retroactive inhibition increases. Sometimes the similarity between original learning and interpolated learning may become so great that the interpolated activity plays the part of rehearsal or practice trial for original activity and serves to strengthen its retention rather than to inhibit it. In this connection Skaggs Robinson states relative degree of retention is maximal when the two activities are identical. The transfer from one task to itself is positive. As similarity decreases, so does degree of recall until it reaches a maximum at an intermediate degree of similarity. Further decrease in similarity upto complete unrelatedness, the degree of retention increases gradually. According to him similarity is of 3 kinds : 1. common elements or items or meaning, 2. similarity with respect to the operations and responses required of the learner and 3. similarity of sets.
3. Amount and strength of original and interpolated learning. If the original activity is better learned than the interpolated activity it is less susceptible to retroactive inhibition (RAI). On the other hand if both the activities (Original and interpolated) are learnt approximately equal in strength retroactive inhibition is maximum.
4. Temporal point of interpolation : Amount of retroaction may vary with the exact point in time at which the interpolated activity is introduced. It is found (1) Interpolation shortly after the end of practice and (2) shortly before the test of retention, produces maximum interference. Interpolation at other intervals yield intermediate degrees of retroaction.

B. *Class Results :*

1. What is the performance of the group in the two series ?
2. Do your group results agree with the theory ?
3. Are there exceptions to group results and to theory ?
4. Are there individual differences in the amount of retroaction.
5. What factor is more potent in causing retroaction in this experiment ?
6. What portion of the list is more easy to learn and reproduce than the other ?
7. What is the application value of this experiment ?

C. *Conclusions :*

1. What is the effect of interpolation on retention.
2. Does your group agree with the theory ?
3. Are there individual differences ?

*Application value :* 1. This helps the students to plan out their studies so that one may not interfere or inhibit the other subject. This is why the students complain that their memory is poor after studying a number of subjects continuously without knowing there is either retroaction or proaction.

(Note : The same experiment can be conducted by taking a controlled group with no interpolation and an experimental group with interpolation)

*Supplementary problems :*

1. Proactive inhibition on retention.
2. Variation in similarity between original and interpolated activity on retention.
3. Variation in time at which retroaction is introduced.
4. Method of measurement on retroaction.
5. Amount and strength of original and interpolated learning on retention.

### **EXPERIMENT NO. 3. RECALL AND RECOGNITION**

**Experimenter :**

**Date :**

**Subject :**

**Time :**

**Problem :** To study the efficiency for retention by recall and recognition—methods using verbal materials.

**Material :** 1. Stop-watch, 2. Writing materials,

3. A set of 15 white cards having a word in each.

4. Another set of 30 white cards having a word in each.

**Plan :** Show the S a set of 15 words for a period for 45 seconds. Ask him to recall and recognise the words. Compare the number of words recalled with words recognised.

*Procedure* : Conduct the experiment in two series—recall and recognition. 1—Recall method—A set of 15 words : Seat the S comfortably. Place before him the first set of 15 cards having one word in each. Tell him that at the signal start, he should start reading the word in each card until he is asked to stop. With these instructions say 'Start' and start the stop watch. Allow 45 seconds to read all the words, at the rate of 3 seconds a word. At the end say 'Stop' withdraw the card and ask him to recall and note down the words he saw.

*II Recognition method* : Mix up the first set of cards with another 30 cards. And ask him to recognise the words he saw previously. Note down the words recognised correctly.

*Precautions* : 1. All the words must be of equal length and difficulty.

2. The S has to pay equal attention to every word of the first set.

3. Make a mark behind each card of the first set for identification by E when they are mixed up with the second set.

4. The S should not be allowed to look into these identification marks.

*Analysis of the results* :

1. Check up the number of words correctly recalled and recognised with reference to the key.

2. Find out how many words are recalled and recognised correctly by the S. Find out the difference between the two.

3. Find out mean, SD, SE and CR for the mean difference.

4. Find out the relationship between the two methods in measuring retention.

Table showing the number of words recalled and recognised correctly by the S and the group. Statistical measures.

Sl.No.	Names	No. of words correctly		
		Recalled	Recognised	Differences
1	A			
2	B			
3	C			
	Mean			
	SD			
	SE			
	CR/t			

### Discussion

#### A. Note :

According to the literature available in this field the individuals do better when they are asked to recognise than when they are asked to recall because in recognition certain cues are actually present unlike in recall. Accuracy in recognition depends upon (1) the similarity or identity between the words seen and read and those with which they are mixed up. Greater the similarity or identity lesser the accuracy in recognition (2) Sense modality to which it is presented i.e., visual, or auditory, etc.. (3) Age (4) Nature of material presented (5) Interval between the presentation of the stimuli and recognition (6) Organic condition.

#### B. Class Results :

1. How many words are correctly recalled and recognised ?
2. Is the difference between two methods statistically significant ?
3. Does your group agree with the theory ?
4. Are there exceptions to the general tendency ?
5. Are there individual differences ? Age and sex differences?
6. What is the application value of this experiment ?

**C. Conclusions :**

1. Which of the two methods measures retention more accurately ?

2. Do individuals differ ?

*Application value :* This experiment has practical significance in testing individual's memory. The multiple choice type of examination is based upon this principle, that recognition gives a more accurate measure of a person's learning and memory.

**Supplementary problems :**

1. Similarity of material on recall and recognition.

2. Nature of materials (words and photographs) on recall and recognition.

3. Sense modality through which material is presented on recall and recognition.

**MODEL QUESTION PAPER, I P.U.C. PSYCHOLOGY****Duration : 3 hours****Max. marks : 90****I Answer the following in 1 sentence each :  $10 \times 1 = 10$** 

1. How did the term 'Psychology' originate ?
2. What is introspection ?
3. What are the two kinds of glands ?
4. Mention the divisions of the central nervous system.
5. What are the sensory organs ?
6. Define 'attention'.
7. Define 'learning'.
8. What is forgetting ?
9. Mention the types of twins.
10. What is stress ?

**II Answer any 10 of the following in 2-3 sentences each:** $10 \times 2 = 20$ 

11. Give any two definitions of Psychology.
12. What is naturalistic observation ?
13. Mention the parts of a neuron.
14. Mention the divisions of peripheral nervous system.
15. Mention the types of attention.
16. What is perception ?
17. What is conditioning ?
18. What is retroactive inhibition ?
19. What is heredity ?
20. What is environment ?
21. Briefly mention the causes of alcoholism.
22. What is balanced diet ?

**III. Answer any 8 of the following in 15-20 sentences each :** $8 \times 5 = 40$ 

23. Explain the subject matter of General and Child Psychology.

24. Explain any two methods of Psychology.

25. With a neat diagram, explain the different parts and functions of neuron.

26. Explain the functions of any two endocrine glands.

27. Explain horizontal-vertical and Muller-Lyer illusion.

28. Explain the determinants of attention.

29. Explain trial-error learning.

30. Explain part-whole and massed-distributed methods of memorization.

31. What is chromosomal abnormality ? Explain any two disorders.

32. What is the role of family and the peer group on children ?

33. What are the causes of stress ?

34. Explain the influence of emotions on mental health.

IV. Answer any 2 in 30-35 sentences each : 2x10 = 20

35. What is forgetting ? What are its causes ?

36. What is sensation ? Explain the visual sensation.

37. Explain the different parts of the Central Nervous System and their functions.

38. Explain mitosis and meiosis.

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